VENTILATING

A MONTHLY MAGAZINE FOR ENGINEERS AND CONTRACTORS CONCERNED WITH COMMERCIAL, INDUSTRIAL AND INSTITUTIONAL AIR CONDITIONING, REFRIGERATION, AIR SANITATION, PIPING, HEATING AND VENTILATION

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Advertising Representatives

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HARRY J. TWINE
148 Lafayette Street
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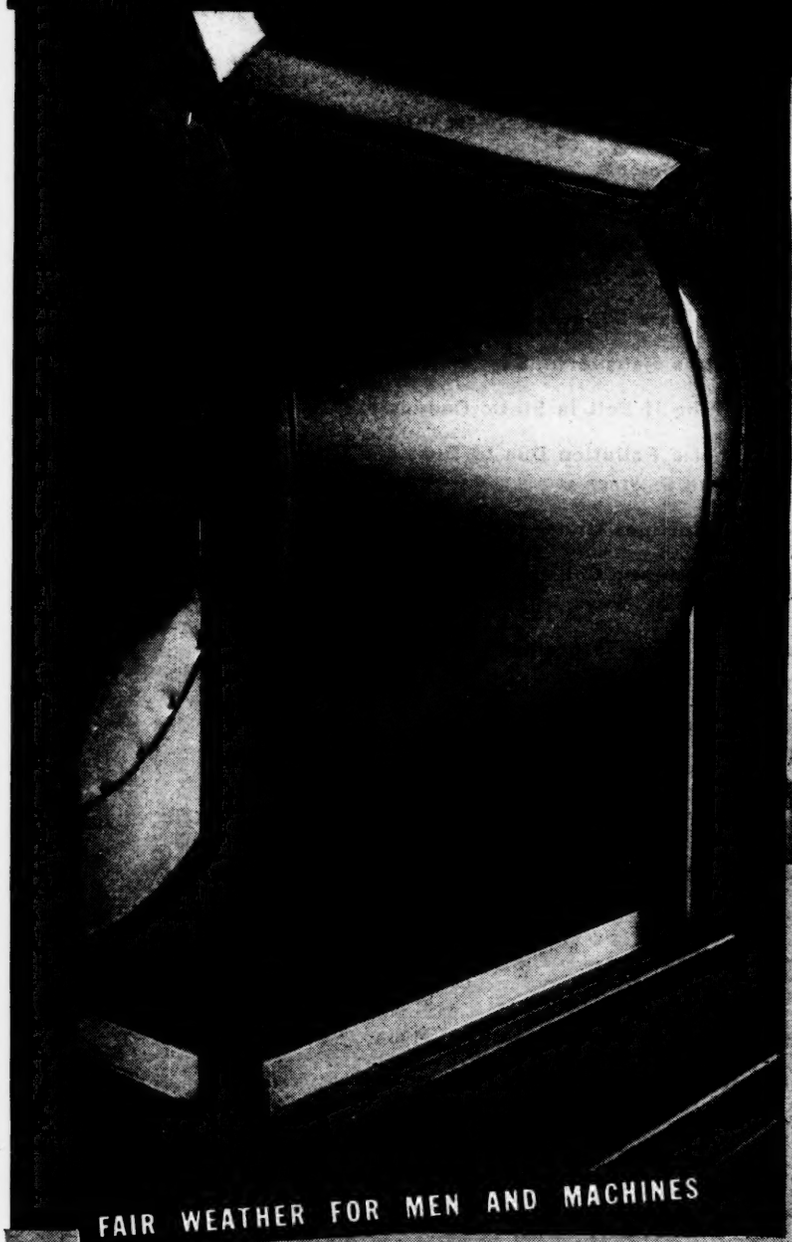
THIS MONTH'S COVER

Transcontinental and Western Air, Inc., photo shows refueling of plane during a night stop. Radiant wall heating of new TWA Stratoliner under flying and stop-over conditions is described beginning page 62.

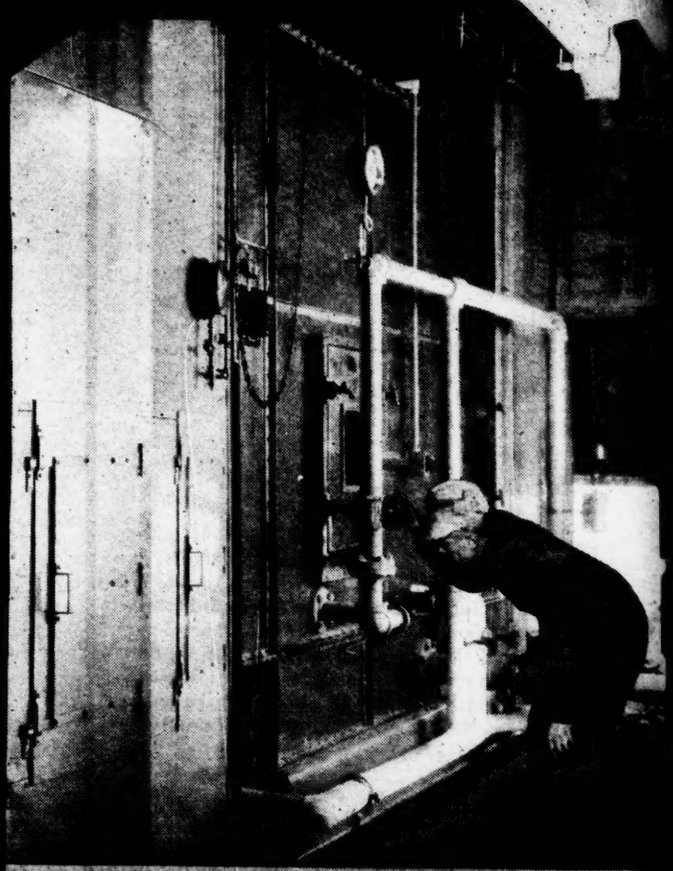
It's 100 to 1 we can help YOU LICK JOBS LIKE THESE

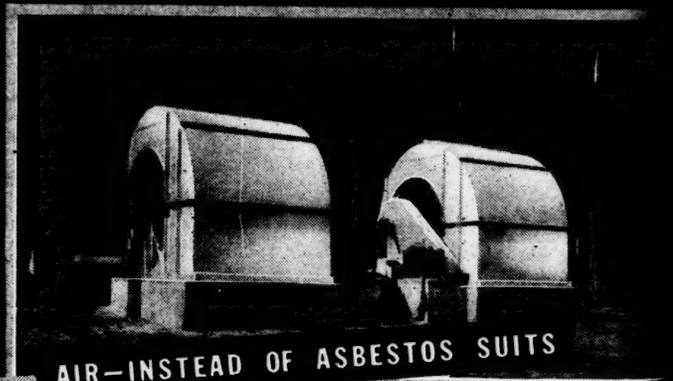


FAIR WEATHER FOR MEN AND MACHINES

JOB—Telephone building requiring year-round comfort for office staff and customers. Also, uniform temperature and humidity conditions in equipment rooms to assure unfailing operation and longer life for precision mechanisms.

ANSWER—Sturtevant ventilation and humidification equipment to properly condition and handle air under a variety of requirements simultaneously.





AIR—INSTEAD OF ASBESTOS SUITS

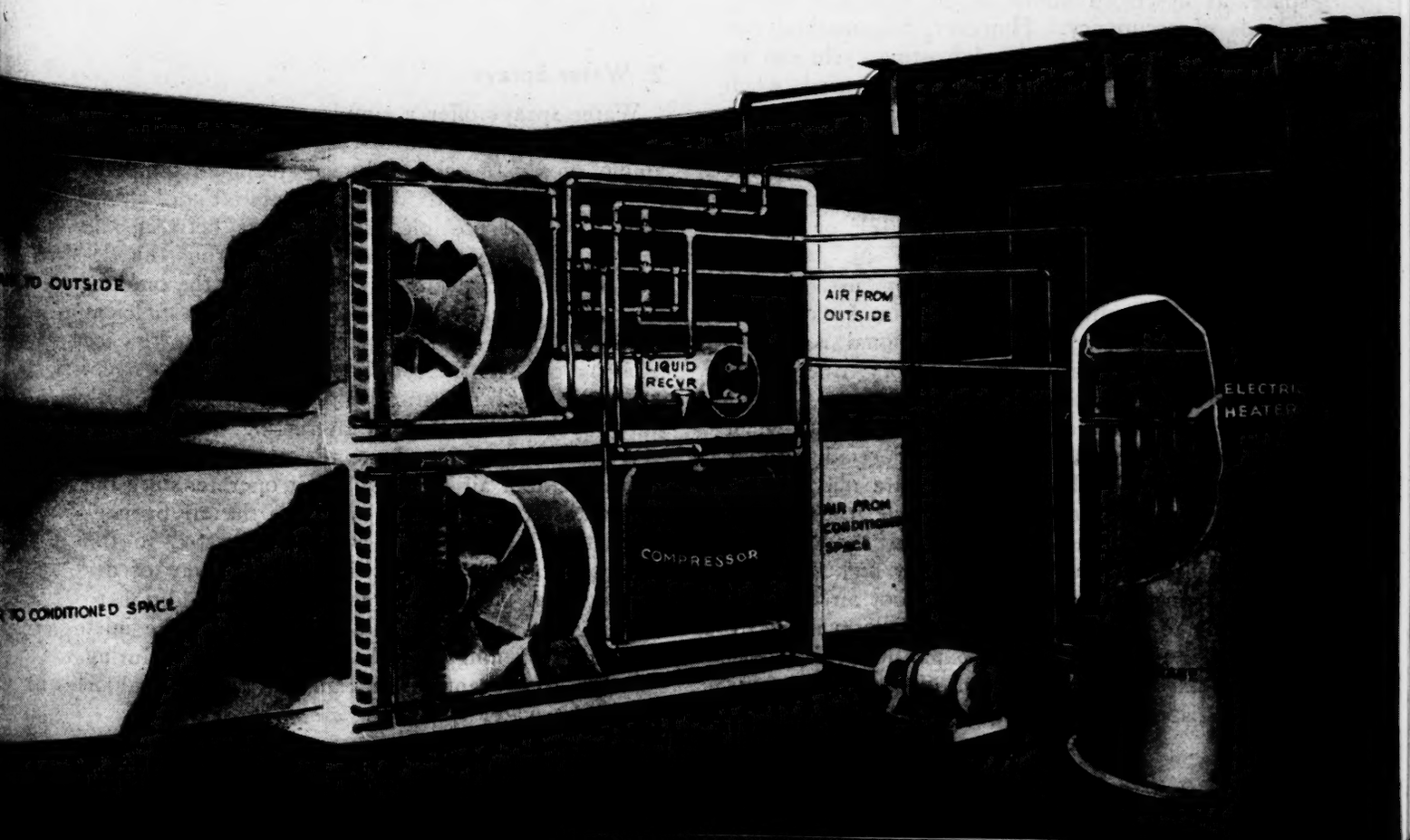
JOB—To enable workmen to get near enough to tend giant aluminum reducing pots—each releasing 100,000 btu's per minute, and 18 rooms of them!

ANSWER—72 Sturtevant Fans (big 15 footers) that deliver a quarter million cfm each on a 24 hour schedule. 945,000 tons of air a day—the biggest concentration of "air at work" we know of.

DEFROSTING of the outdoor coil of a heat pump is necessary because, when high relative humidity air at a temperature of 32F or below is encountered, moisture in the air is condensed and frozen on the colder heat absorbing surface. If periodic defrosting is not provided, ice will accumulate on the surface to a point where the heat transfer between the air and refrigerant will be seriously affected, causing the compressor to operate at a lower suction pressure, with a corresponding reduction in output and coefficient of performance.

Some of the methods covered in the following discussion have been extensively used in the defrosting of evaporators in conventional refrigeration systems with some degree of success. However, the other methods have recently been developd and, for the most part, still are untried, but they are believed to offer sufficient possibilities for use on future installations to be worth considerable thought and study.

[illegible] four basic cycles or arrangements of a heat pump—sometimes called the reverse refrigeration cycle—for making use of a refrigerating compressor to both heat buildings in winter and cool them in summer. This article created so much interest and comment as to the best methods for defrosting the outdoor air coil in the winter when air is used as the heat source that a more detailed discussion on this phase of the subject has been prepared at the request of the editors.



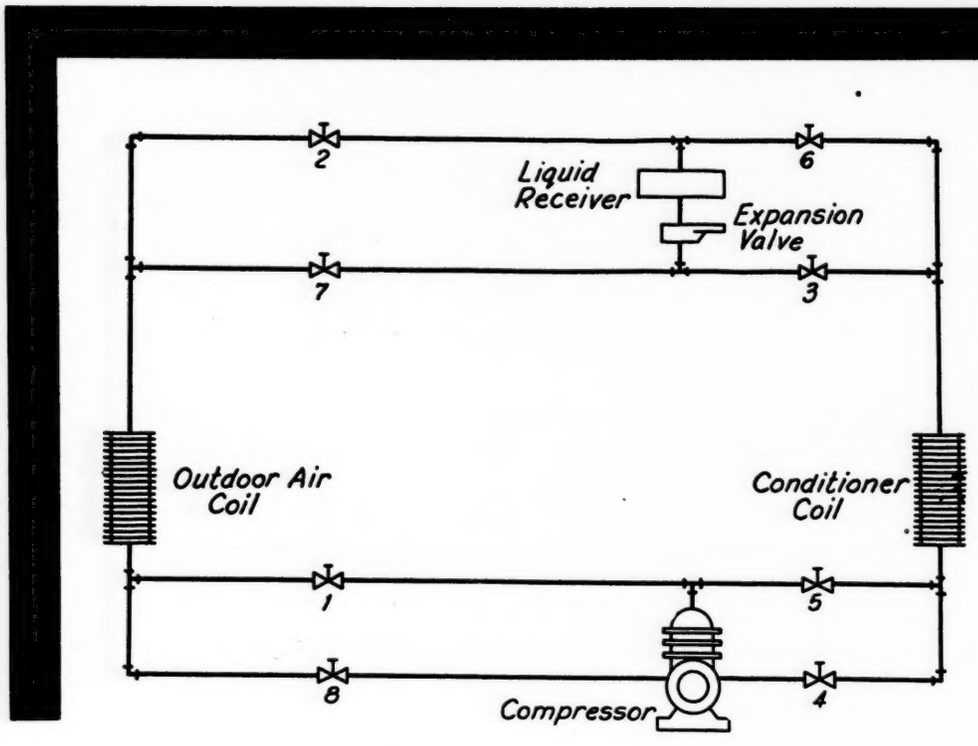


Fig. 1. Most convenient method of defrosting heat pump in winter is to reverse its cycle. Open valves 1, 2, 3, and 4; close valves 5, 6, 7, and 8.

1. Reversing the Cycle

Perhaps the most obvious and the most convenient way of defrosting the outdoor air coils is to reverse the cycle of operation. By opening valves 1, 2, 3, and 4 and closing valves 5, 6, 7, and 8 (Fig. 1), the outdoor coil becomes the condenser and the conditioner coil the evaporator. Reversing the cycle, as described, makes available for defrosting the heat removed by the evaporator from the air or other medium going to the conditioned space plus the heat equivalent of the work of compression added to the refrigerant.

Usually, removal of heat from the conditioned space, as described above, is objectionable during periods of occupancy. However, this method can be made satisfactory if the defrosting cycle can be timed to occur at night or during other periods when the space is unoccupied. Unfortunately, such synchronized operation is not feasible for many installations, since defrosting is necessary at least three or four times during the day. This is particularly true when the outdoor air is cold (32F or below) with high relative humidity.

Unless precaution is exercised in use of this method of defrosting, the thermostatic expansion valve, normally used in a conventional refrigeration system, is not usually satisfactory, due to the resulting low compressor head pressure brought about by the extremely high condensing rate when the refrigerant gas is delivered to the cold outdoor air coil. Since this low head pressure may not be sufficient to open the expansion valve, the evaporator would be starved, causing a low suction pressure and thus resulting in little if any high temperature gas being delivered to the outdoor air coil.

Starving of the evaporator can be prevented by having a bypass around the expansion valve containing a fixed orifice and a shutoff valve. The shutoff valve is opened for a short period during the defrosting cycle, thus allowing the refrigerant flow to the evaporator to be governed by the fixed orifice. The fixed orifice can be sized to allow sufficient refrigerant flow at the low head pressure. A possible alternate scheme is to install on both sides of the outdoor air coil louvers which could be closed during the defrosting cycle, thus decreasing the heat loss to the surrounding ambient air. These are two of several methods which may be used to prevent the difficulty and allow the system to defrost satisfactorily. These suggested methods may or may not be applicable to every installation. However, the possibility of trouble is pointed out here so it can be kept in mind when designing a system of this type.

2. Water Sprays

Water sprays offer a simple and easy method of defrosting the outdoor coil in locations where an ample supply of chemically suitable high temperature water (50F or above) is available. Fig. 2 shows one of several possible arrangements between the sprays and the outdoor air coil. During the defrosting cycle the water is sprayed onto the outdoor air coil in sufficient quantities and with sufficient velocity thoroughly and quickly to remove the ice from the coil. If the coil is four or more rows deep, it may be found necessary to provide sprays on both sides to obtain satisfactory defrosting.

While this is being done, the air circulating fan for the outdoor air coil should not operate, since the heat transferred from the water to the air by conduction and evaporation would be wasted to the outside with little accomplished in the way of defrosting. In fact, it is a good plan, in addition to stopping the fan, to provide dampers on the inlet and outlet openings, which would be closed during the cycle to prevent the entrainment of the outdoor air by the water spray.

Operation of the compressor during the defrosting cycle depends on existing conditions. It is natural to assume that the temperature and quantity of the water is sufficient to maintain the suction temperature above 32F, thus causing defrosting instead of a further accumulation of ice on the coil. There is, therefore, no technical reason why the compressor cannot be operated. On the other hand, operation of the compressor would require the use of an increased quantity of water, since heat would be absorbed by the refrigerant being circulated through the coil in addition to that required for defrosting. Therefore, in each case it has to be determined if it is economically justifiable to operate the compressor and to use a larger quantity of water, but to have a continuous heat flow to the conditioned space, or whether to use less water and have an interrupted heat delivery. When using water sprays provisions must be made so that the water leaving the coils will not accumulate in the drain pan and pipes to form ice when the cold outdoor air is again circulated over the coil.

If the cost of water is appreciable, it may be more economical to use a recirculated system instead of a once-through system. In the recirculated system the water, after passing over the coils, is returned to the sprays by a pump. The supply water to the sprays is maintained at the desired temperature by mixing the recirculated water with a certain percentage of the higher temperature make-up water. Generally, the water is reduced very little in temperature in a single pass over the coil, so that the recirculating system, in cases where high temperature water is available, results in considerable reduction in the amount of total water used. However, to determine if this type system is justifiable, this saving will have to be balanced against the cost of additional equipment and increased operating and maintenance costs of the system.

When returning to the heating cycle from the defrosting cycle in such an arrangement, it is preferable to start the fan a little ahead of the refrigerating compressor so that the water clinging to the coil will be removed before the surface temperature is reduced below freezing.

The water spray method of defrosting has been used on several installations and has proven quite satisfactory. The chief difficulty is to obtain sufficiently high temperature water when the outdoor temperature is approximately 30F and lower. Water in the city mains, particularly in the colder climates, is usually at such a low temperature as to require considerable quantities to obtain satisfactory defrosting. The large quantities required, if combined with a high unit cost of the water, will usually prohibit this source. However, water from wells, lakes, rivers, or from manufacturing processes, offers excellent possibilities. It cannot be stressed too strongly that use of water necessitates the use of non-corrosive or specially treated metals to prevent corrosion of the exposed parts and thus eliminate the additional expense and maintenance which otherwise would be required for the operation of such a system.

3. Solid Adsorbents

In a solid adsorbent system silica gel, activated alumina, activated carbon or a similar material is employed to dehumidify the air before passing the outdoor coil and thus eliminate frost accumulation. One of several schemes employing this principle is shown in Fig. 3. The solid drying agent is carried in a continuous rotating screen just ahead of the outdoor air coil. The screen or bed is rotated at a speed to permit the proper time of contact in the reactivation and dehydration cycle. Water vapor in the outdoor air condenses as it passes through the adsorbent bed, giving up the latent heat of condensation, plus the so-called heat of mixing to the

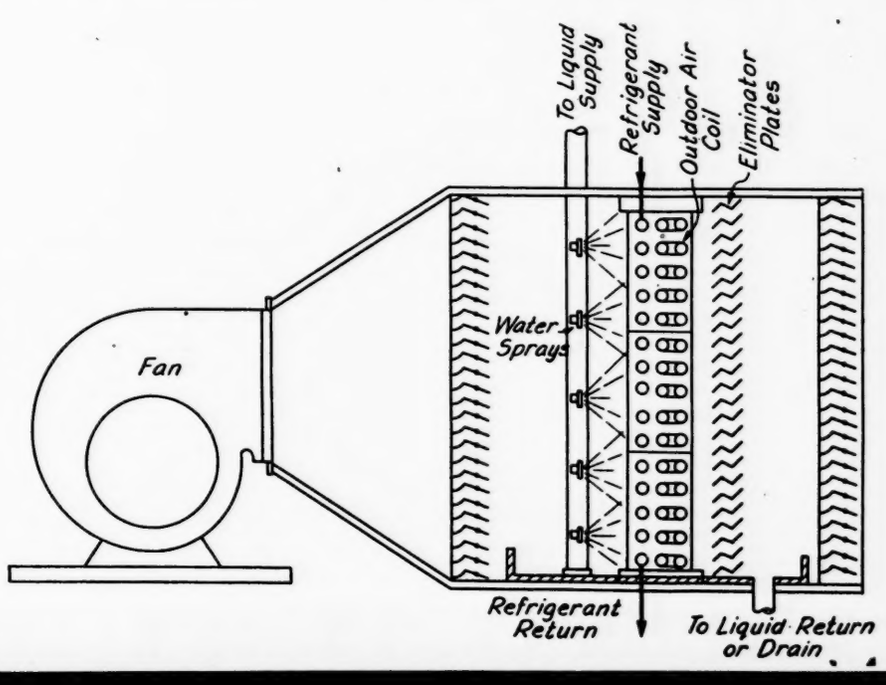


Fig. 2. Use of water sprays for defrosting where ample and suitable water is available.

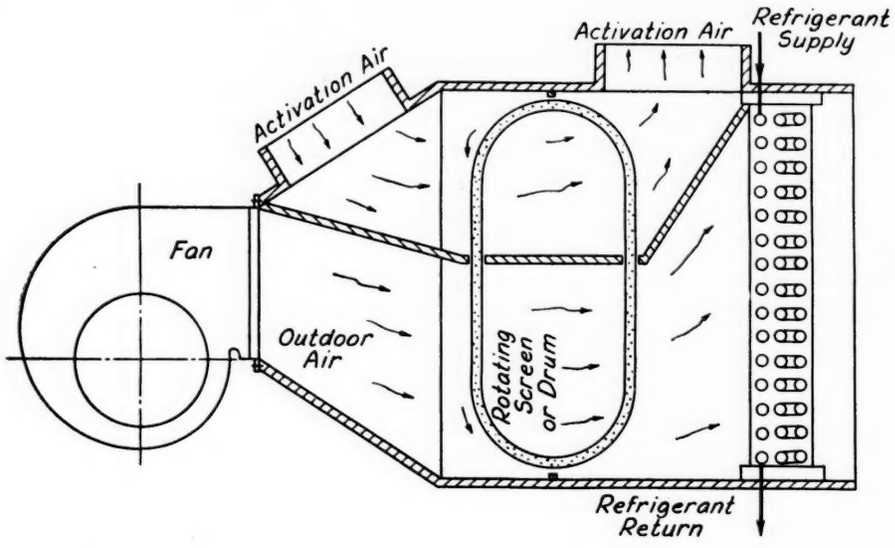


Fig. 3. One method of using adsorbents for dehumidifying air so that frost does not accumulate on the coils.

air. This dry air then passes on to the coil where as much of the sensible heat as possible is removed.

While the lower portion of the rotating drum is used for dehydration, the upper portion can be reactivated. Any source of clean heated air can be used for activation at temperature normally ranging from 300 to 350F. The air can be heated by electric heaters, steam, or any other heat source.

The main advantage of such a system, as shown in Fig. 3, is that it allows a continuous supply of heat to the conditioned space by the heat pump, since part of the adsorbent can be activated while the other part is dehumidifying the air. However, this advantage is offset to some extent by the initial cost of such a system and by the fact that an auxiliary source of heat has to be employed. At the present time such a system is not commercially practical but it offers sufficient possibilities for further investigation and study.

4. Liquid Absorbents

Instead of using water sprays as described under method 2, it is possible to use a liquid absorbent. This type of absorbent is usually a water solution of lithium chloride, calcium chloride, lithium bromide, or a similar liquid. The vapor pressure of such a solution is reduced to a suitable level by governing its concentration and temperature.

Liquid absorbent is brought into intimate contact with the air by sprays similar to the method described for water defrosting. Since the aqueous brine solution has a lower vapor pressure, moisture in the air will be absorbed by the solution resulting in a conversion of latent heat to sensible heat, which raises the solution temperature and consequently the air temperature. The dry air then passes on to the coil where as much of the sensible heat as possible is removed.

Excess water of condensation, which tends to dilute the brine, is removed in what is called the "solution concentrator." In this concentrator the moisture is evaporated from the brine by an auxiliary source of heat into a stream of air taken from and discharged to the outside.

This type system is employed quite extensively for evaporator defrosting of refrigeration systems used to maintain testing rooms and the like at extremely low temperatures. In this method an external source of heat is necessary, just as in the solid adsorbent method; consequently the same disadvantage applies.

It might be pointed out in this connection that where an external source of heat is necessary for defrosting, the coefficient of performance of the system is reduced in proportion to the amount of heat applied externally since the

$$\text{C. O. P.} = \frac{\text{heat output to the conditioned space}}{\text{total heat input to system}}$$

5. Electrical

Several possibilities exist for defrosting the outdoor air coil electrically. One method would be to locate a bank of electric strip heaters adjacent to the coil surface. Then, during the defrosting cycle the outdoor air fan is stopped and the damper on the inlet and outlet closed to make the electric heat as effective as possible. In this manner the coil would be defrosted by the convected and radiant heat from the bank of electric heaters. Since considerable time is required for this method of defrosting, the defrosting cycle must occur at rather frequent intervals so as to keep the inoperative time of the heating cycle to a minimum. The efficiency of this method is quite low because a large percentage of the heat is necessarily wasted to the ambient air instead of defrosting the coil. In most locations, this method may be prohibitive unless the cost of electric energy is extremely low.

An alternate method of electric defrosting which offers great promise is to heat the surface of the coil itself instead of the ambient air around the coil by an arrangement similar to that shown in Fig. 4. In this scheme the coil acts as an electric resistance,

and by the application of low voltage and high current the coil surface temperature rises quickly, thus melting the ice. A coil used in this method should have as much surface as possible in series in order to keep the voltage and required amperage within reasonable limit. How the values of voltage and current are affected by the amount of surface in series can be seen by the following example.

Assume that each of the three rows shown in Fig. 4 consist of 82 feet of finned tubing with an average resistance of .009533 ohms and that 1/64 inch of ice has accumulated on the tubes. For such a surface the heat required per linear foot would be approximately 2.38 Btu to melt the ice, 2.74 Btu to raise the surface 50F, and 78.65 Btu per hr heat loss. Then the total electric power required for each row, assuming a ten minute defrosting cycle, would be 342 watts to melt the ice, 394 watts to raise the surface temperature and 1890 watts due to heat loss to ambient air, giving a total demand of 2626 watts.

Then, by using the two well-known formulas:

$$\text{Watts} = I^2R \text{ and } E = IR,$$

the voltage and amperes for one row would be 5.0 volts and 524 amperes. If the three rows are connected in series, 15.0 volts, 524 amp and 7.9 kw would be required. On the other hand, the three rows connected in parallel would require 5.0 volts, 1572 amp and 7.9 kw.

It can be seen that with the parallel arrangement as compared with the series method, the current is increased three times and the voltage reduced one-third. The series arrangement would obviously be the more practical setup, since the parallel would require values of current much too high for the average installation. However, there is a limit to the amount of tubing which can be used in series for an evaporator and still obtain proper operation and performance when considered from the refrigerant side of the circuit. One method of putting the surfaces in series electrically, and yet allow the refrigerant to flow in parallel paths, can be accomplished by using non-conductor connections in the location indicated on Fig. 4.

An alternate method is to install several immersion heaters in the tubes themselves instead of using the outside surface for resistance. These electric heaters could be placed at the top and bottom of the coil to heat up the refrigerant sufficiently to cause it to boil up through the coil, thus heating the surface and melting the ice. This method would, in most cases, require a special coil and the cost would in all probability be more than that of the surface method.

6. Two Outdoor Units

A heat pump system incorporating two smaller outdoor coils instead of one single large unit offers a means of defrosting one coil (without using any supplementary heat) while the other is being used to supply heat to the conditioned space. Such a system is shown schematically in Fig. 5.

For normal operation, valves 1, 2, 3, 4, 5, and 6 would be open, valves 7, 8, 9, 10, 11, and 12 would be closed. The compressor would deliver the hot compressed gas to the conditioner coil where it would condense, giving up the latent heat of condensation to the conditioned space. From the conditioner coil the liquid refrigerant flows to the liquid receiver, then through the expansion valves to the two air coils where heat is absorbed from the outdoor air. From the outdoor air coil the refrigerant gas returns to the compressor to repeat the cycle.

In defrosting outdoor coil No. 1, valves 1, 2, 5, 6, 7, and 8 are opened and valves 3, 4, 9, 10, 11, and 12 are closed. During this cycle the compressor delivers the hot compressed gas through two parallel paths consisting of valve 1, conditioner coil,

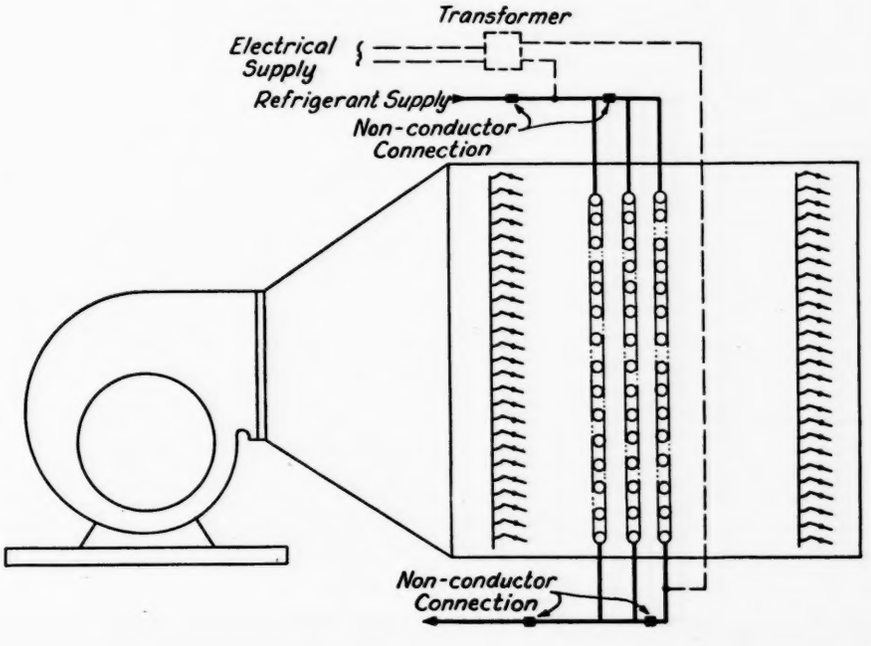


Fig. 4. One method of electric defrosting is to heat the coil itself electrically as shown here.

valve 2, the liquid receiver on the one hand and valve 7, outside surface No. 1, valve 8 and the liquid receiver on the other. From the liquid receiver the refrigerant goes to coil No. 2, then back to the compressor. The hot gas going to the outdoor coil No. 1 would be condensed, giving up the latent heat of condensation to melt the ice. During this cycle the outdoor coil No. 2 would act as the evaporator, absorbing heat from the outdoor air for use in the conditioner coil.

In defrosting outdoor coil No. 2, valves 1, 2, 3, 4, 9, 10 are opened and valves 5, 6, 7, 8, 11, 12 are closed. The compressor delivers the hot gas to the conditioner coil and outdoor air coil No. 2 simultaneously, similar to the path described for defrosting outdoor coil No. 1. The hot gas going to the outdoor coil No. 2 would be condensed, giving up its latent heat of condensation to melt the ice. During this cycle the outdoor air coil No. 1 absorbs heat from the outdoor air for use in the conditioner coil.

During the cooling cycle, in this type system, both of the outdoor coils are used as air-cooled condensers and the conditioner coil the evaporator. It will be noted that the equipment required in this system is the same as for the system described in Fig. 1, except for the addition of four valves and the use of two smaller outdoor air coils instead of one large one. The chief advantage of this system over system No. 1 is that one-half the normal amount of heat can be supplied to the conditioned space while one coil is being defrosted. The chief disadvantage is that the initial cost is somewhat higher and the heat used for defrosting is obtained from the outdoor air at a time when it is at a relatively lower temperature level, thus reducing somewhat the overall coefficient of performance of the system. On the other hand, this type would have a higher C.O.P. than those defrosted with electric energy which have a 1:1 conversion ratio or those using other forms of external heat described under methods 1 to 5, inclusive.

7. Storage System

The storage system shown schematically in Fig. 6 offers possibilities of storing water or other liquids at a relatively high temperature during offpeak and off-cycle periods for heating the conditioned space as well as for defrosting the outdoor air coil. With this type system, defrosting can be simultaneous with the heating of the conditioned space. In this method the heat pump itself, or auxiliary heating such as electric heaters, or both, can be used to charge the storage tank. Since the storage tank can be charged in mild weather for use as booster heat during extremely cold days, it is possible to size the compressor and other equipment to have an output somewhat less than that required for extremely low outdoor temperature. This possibility not only allows use of a smaller compressor and other refrigeration equipment to satisfy the conditioned space year round, but also results in a higher coefficient of performance, since charging the tank during periods when the outdoor temperature is relatively high allows the operation of the system at a higher suction pressure than otherwise would be possible.

During the heating cycle, in the case of the heat storage type of system, valves 5, 6, 7, 8 are opened and valves 1, 2, 3, 4 are closed. Compressed refrigerant gas passes through the coils in the water storage tank where it is condensed, giving up the latent heat of condensation to the water in the storage tank. Condensed refrigerant then passes on to the liquid receiver, then through the expansion valve to the outdoor air coil where heat is absorbed from the outdoor air. From the outdoor air coil the refrigerant gas returns to the compressor.

During the cooling cycle, valves 1, 2, 3, 4 are

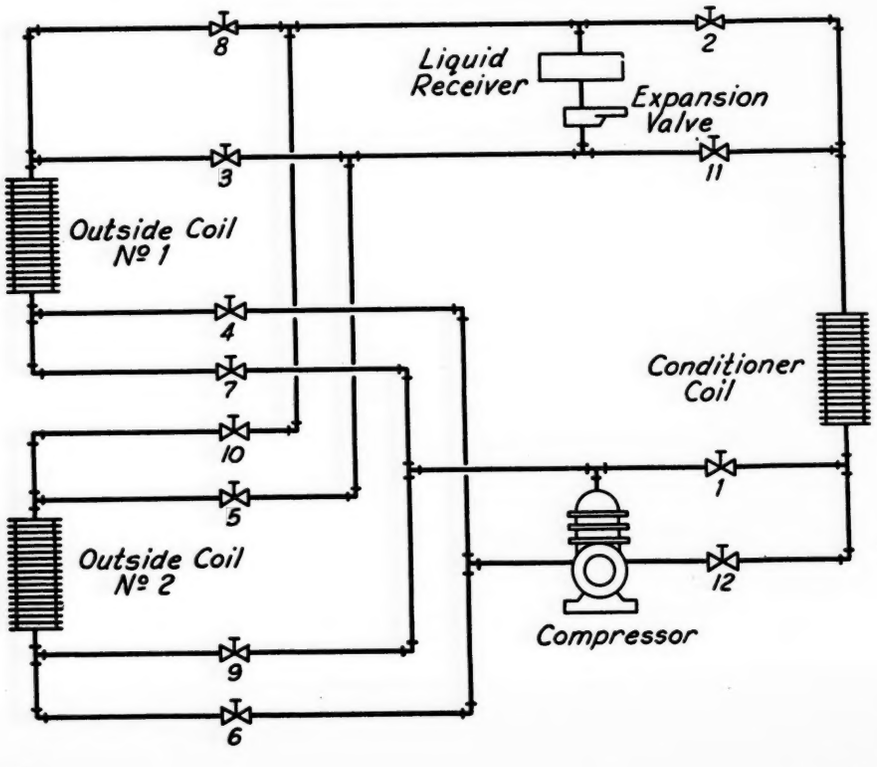


Fig. 5. By using two small coils instead of one large outside coil it is possible to defrost one while the other is supplying heated air to the conditioned space.

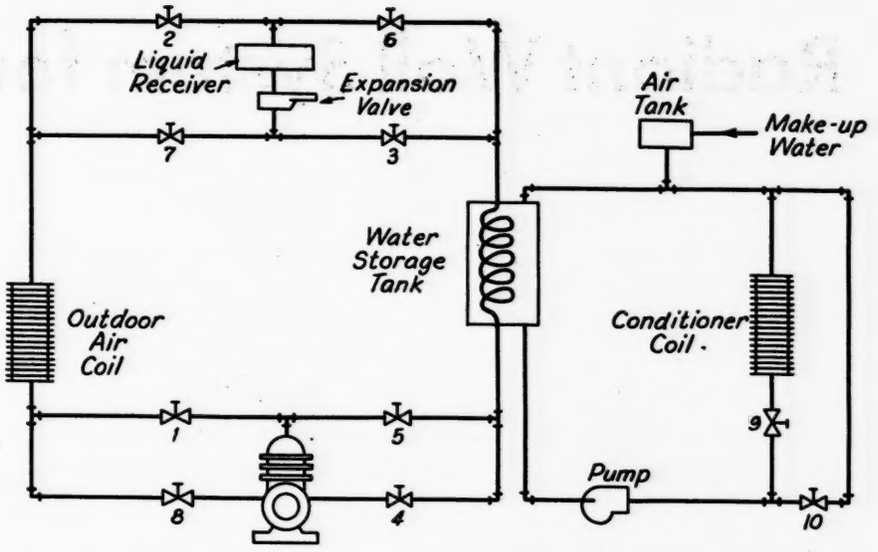


Fig. 6. Storage system in which water is heated during off-peak and off-cycle periods for heating the conditioned space and for defrosting the coil as well.

opened and valves 5, 6, 7, 8 are closed. Compressed refrigerant gas passes through the outdoor air coil where it is condensed, giving up the heat of condensation to the outdoor air. Condensed refrigerant passes on to the liquid receiver, then through the expansion valve to the water storage tank where the heat of vaporization is absorbed from the water. From the water storage tank the refrigerant gas returns to the compressor.

During the defrosting cycle the path of the refrigerant is reversed from that used for the heating cycle, going first to the outdoor air coil, then on to the liquid receiver, through the expansion valves, the water storage tank coils, back to the compressor. The coil in the water storage tank, now the evaporator, absorbs the heat from the water in the storage tank and the compressor delivers this heat together with the heat equivalent of the work of compression to the outdoor air coil where it is used to defrost the coil. Since there is considerably more heat in the water storage tank than would be required for defrosting, the circulating pump can still deliver simultaneously the heated water to the conditioner coil.

Circulation of the water from the water storage tank, through the pump to the conditioner coil, then back to the tank, is the same during the heating, cooling and defrosting cycles, the only difference being that during the heating cycle hot water is stored in the tank which can be delivered to the conditioner coil by the pump; while during the cooling cycle cold water is stored in the tank to be circulated through the conditioner coil when required by the system.

The great advantage of this system is that the refrigerating equipment can be sized to satisfy the average temperatures during both the heating and cooling cycles instead of the minimum and maximum temperatures, thus materially reducing the size of the equipment installed. Whenever excess capacity exists in the system (that is, during times when outdoor temperature is below the average maximum in summer and above the average minimum in winter) the system can be used to charge the tank with hot or cold water, depending on the cycle. Also, as has been pointed out, heat from the storage tank can be used to defrost the outdoor coil without interrupting the flow of heat that takes place to the conditioner coil.

8. Conclusions

Methods 1, 2, and 4 have been employed for evaporator defrosting to a limited extent. However, it is apparent that application of a system using air as the heat source is limited until considerable improvements are made in the known methods or until more satisfactory methods are developed for defrosting the outdoor air coil under all conditions of operation and for all outdoor temperatures.

The method to be employed in the defrosting cycle depends to a great extent on the climatic conditions which will be encountered. In locations where outdoor temperatures seldom fall below 32F the defrosting problem is not serious and methods 1 and 2 may be successfully and economically applied. On the other hand, if the outdoor temperature falls below 32F quite frequently, with a corresponding high relative humidity, design methods similar to 3-7 may be applicable. In developing a suitable method, particular attention should be given to the off-peak storage method outlined under method 7, since as has been pointed out, in addition to having an ideal defrosting cycle, it provides means of storing hot water, off-peak, during mild weather for use on colder days, thus reducing the size of refrigeration equipment required and also improving the coefficient of performance. Also, this type system offers means of storing cold water, off-peak, during mild weather for use during the extremely hot days of the summer. In short, this type of system offers a means of providing equipment that is well balanced from the standpoint of first cost and operating cost.

EDITOR'S NOTE: In addition to the January, 1944, article in this publication, Messrs. Sporn and Ambrose are the authors of two other papers on the Heat Pump, as follows: "Description and Performance of Two Heat Pump Air Conditioning Systems," *Journal ASHVE*, June, 1944, pp. 377-385; and "The Heat Pump—An All Electric Heating and Cooling System," presented before the Annual Meeting, ASME, December 1, 1944.

Radiant Wall System for Stratoliners

Packaged Combustion Heaters Add to Comfort of TWA Passengers in the New Boeing Stratoliners

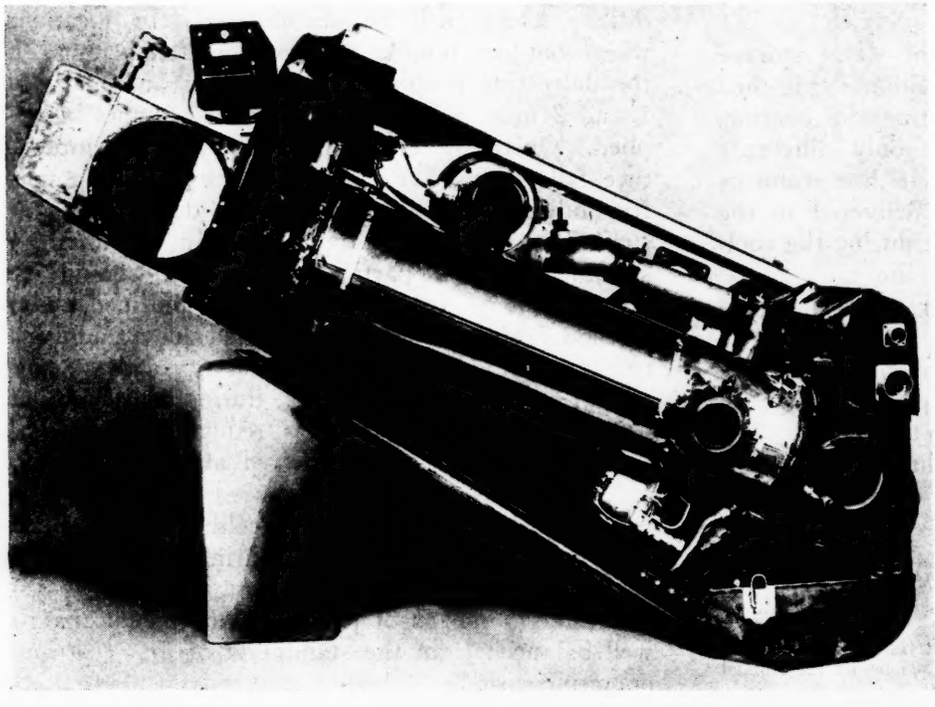
ENGINEERS at Transcontinental and Western Air, Inc., call it a "radiant wall" system; in fact, it is a combination of radiant and convection heating. The principle is to circulate warmed air between the insulated inner surface of the skin of the airplane and the linen interior finish walls of the cabin, then to introduce the air directly into the cabin.

The idea of an easily replaceable heating package is brand-new and the Stratoliners are the first to use it, but it is beyond the experimental stage.

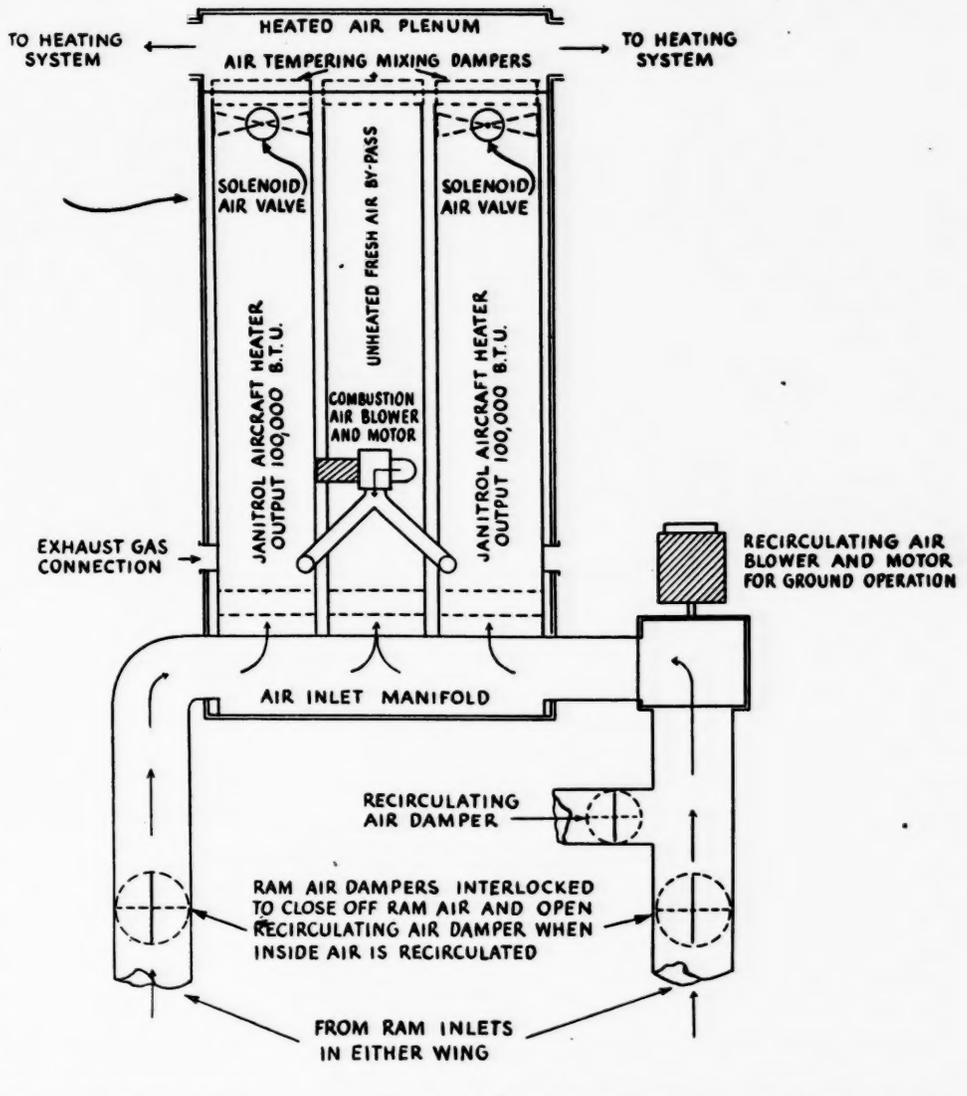
Continuous control of the circulated air in flight and on the ground is possible because of the combustion type heaters which operate independently of the plane's engines. TWA engineers in collaboration with the heating engineers of Surface Combustion Corporation have developed what they call a heating package which fits into the belly of the ship by dropping a quick-access panel. The package includes two Janitrol aircraft heaters of 100,000 Btu per hr capacity each and is complete with all thermostatic controls, fuel pumps, combustion air blower, ventilating air blower, necessary dampers and other devices for automatic operation. Thus, one heater package may be slipped out of the plane for maintenance and be replaced by another.

In flight, one of the twin heaters is normally sufficient to warm the airplane, so if there should be one heater failure, there still would be adequate heat. After over 1,000 hours of flight, TWA reported there had been no failures or special maintenance work on the heaters.

In operation, the two combustion-type heaters are



The two heaters in the package assembly are identical in appearance. Each is 8 inches in diameter and approximately 36 inches long. Outside air enters at the right; heated air leaves through mixing chamber at left.


HEATED AIR PLENUM
TO HEATING SYSTEM
TO HEATING SYSTEM
AIR TEMPERING MIXING DAMPERS
SOLENOID AIR VALVE
SOLENOID AIR VALVE
UNHEATED FRESH AIR BY-PASS
JANITROL AIRCRAFT HEATER OUTPUT 100,000 B.T.U.
JANITROL AIRCRAFT HEATER OUTPUT 100,000 B.T.U.
COMBUSTION AIR BLOWER AND MOTOR
EXHAUST GAS CONNECTION
RECIRCULATING AIR BLOWER AND MOTOR FOR GROUND OPERATION
AIR INLET MANIFOLD
RECIRCULATING AIR DAMPER
RAM AIR DAMPERS INTERLOCKED TO CLOSE OFF RAM AIR AND OPEN RECIRCULATING AIR DAMPER WHEN INSIDE AIR IS RECIRCULATED
FROM RAM INLETS IN EITHER WING

Arrangement of principal parts of the heater package.

continuously cycled on and off under automatic control. At no time is the surface temperature of the radiant walls in excess of the design temperature of 90F.

Warmed outside air and cold air are blended for cabin circulation by thermostat control. Outside air is always moving gently through the cabin whether or not heat is required. Two air intakes at the leading edges, one in either wing, bring air under ram pressure to the heaters when the plane is in flight. These two intakes meet in a manifold at the fresh air inlet end of the heater package assembly. The manifold supplies fresh air for heating, unheated fresh air for ventilation, and combustion air.

Separate blowers are used to supply air for heating and for combustion when the airplane is not in flight. By damper arrangement, the ventilating air blower can be used to recirculate cabin air either while on the ground or in flight.

Heat Source

Combustion takes place within a cylindrical gas-tight alloy steel shell at the center. Combustion air is introduced and sets up a whirling action. Gasoline is injected into the whirling air by means of a spray nozzle. The resulting mixture is ignited by a continuously firing spark plug. The flame whirls down the length of the combustion tube. With combustion completed at the end of the tube, the burned gases are then exhausted through a return manifold which is a gas tight welded assembly integral with the primary combustion tube.

The combustion tube heat exchanger assembly is completely jacketed by an alloy steel shell. Air from the outside air manifold passes over all the surfaces of the heat exchanger at high velocity. Warmed in this way, it enters the heated air manifold from which it is piped to the duct system.

Main ducts lead from the outlet manifold of the package to both sides of the cabin and connect with ducts which run the full length of the cabin on either side just below the floor level. A duct also leads to the Stratoliner's nose where it supplies heated air for windshield defrosting and cockpit heating. Ducts lead to the inboard nacelles to provide heat for all four engines during cold weather station waits.

In flight, air for the heating system is provided by ram pressure. When the plane lands the flight engineer shuts off ram air and turns on electrically operated blowers in the heating package. This arrangement permits ground heat and ventilation without interruption.

In warm weather the cabin system

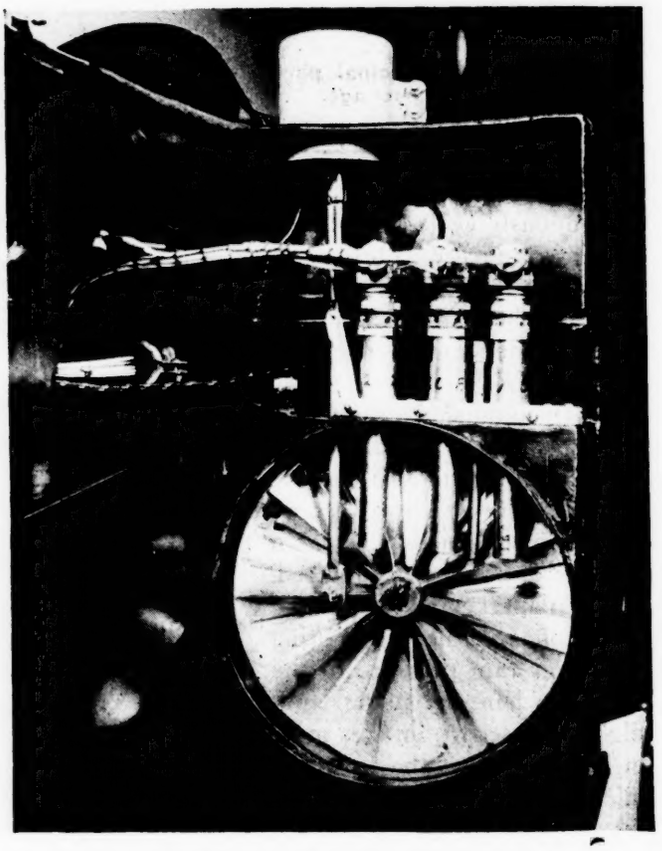
Cutaway view of heater unit showing flame in combustion chamber. Gasoline and air introduced at right and exhausted through vents shown at left end of chamber.

operates without the heaters. Ram pressure keeps cool air circulating in flight. After unheated fresh air has passed across the wall panels and has entered the cabin, it is released through the exhaust in the belly of the plane. Before landing, the inlet scoops are closed. This retains the cool air. The blower in the heater package recirculates this air during station stops. During extremely cold weather, the inlet scoops also may be closed and cabin air recirculated to avoid taking in an excess of cold, dry air.

The heater control system is built to handle any quick shift in temperature encountered, especially when the plane ascends or descends rapidly. A Minneapolis-Honeywell electronic type thermostat which controls the dampers for mixing hot and cold air may completely shut off either hot or cold air flow, so that only hot or cold air is moving through the system as required. Ram pressure switches automatically turn off the ram-operated heating system when landing in event the flight engineer fails to turn on the ground operating blowers. A solenoid operated air valve stops air flow through a heater when it is turned off. There are seven basic switches placed at key positions in the heating package, any one of which can shut the whole system down and flash a warning light in case of overheating.

The flight engineer operates the heating system from the cockpit. He has one panel for automatic temperature and air circulation control, another for manual control. The manual control is for check testing equipment and auxiliary use. The thermostat regulates air control valves electronically and, when once set, maintains a constant temperature.

The inner surface of the plane's skin is lined with a padding of spun glass impregnated with a Bakelite bonding material which is a low conductor of heat and sound. Between this insulated surface and the linen lining of the cabin interior, warm air flows from the floor level, up along the back of the inner finished wall surface and out into the cabin at low velocity through vents above the hat rack compartments. The warm air used for heating the wall surfaces is thus used also for cabin ventilating.

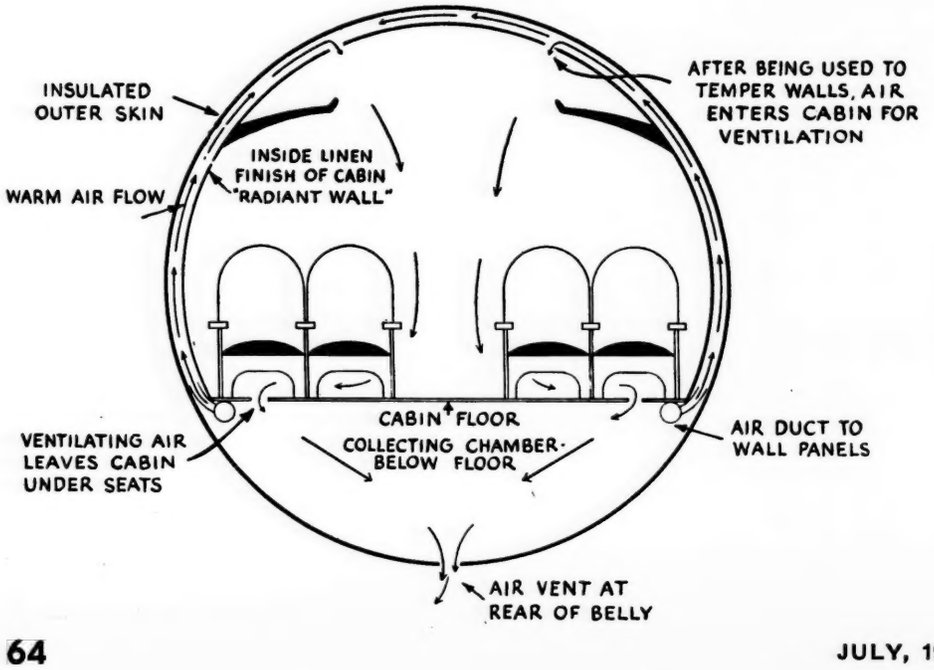


A solenoid operated air valve stops air flow when heaters are turned off. Other automatic controls regulate heating and ventilating under varying conditions.

One-inch diameter outlets at 16-inch intervals along the duct under the cabin floor line force air up back of cabin walls between the rings. This air also travels between the panes of the double windows.

Warm as the cabin itself might be, the radiation of body heat to cold wall surfaces causes discomfort. Maintaining temperatures at levels near the body temperature results in maximum passenger comfort.

TWA contemplates a similar heating system for its forthcoming Lockheed Constellation, the 57 passenger transport now in military service, as well as for other types of commercial planes.


INSULATED OUTER SKIN
INSIDE LINEN FINISH OF CABIN "RADIANT WALL"
WARM AIR FLOW
AFTER BEING USED TO TEMPER WALLS, AIR ENTERS CABIN FOR VENTILATION
CABIN FLOOR
COLLECTING CHAMBER BELOW FLOOR
VENTILATING AIR LEAVES CABIN UNDER SEATS
AIR DUCT TO WALL PANELS
AIR VENT AT REAR OF BELLY

Section of Stratoliner cabin showing flow of warmed air for heating walls. Air is vented into cabin at top for ventilation and additional heat value. Large number of openings insures low velocity.

New Developments in Washington

More Oil for East; Engineering Standards to be Studied; Supply of Piping and Sheet Metal Disappointing

LORING F. OVERMAN

PERHAPS the best way to summarize the between V-days position of the heating, ventilating and air-conditioning industries is to observe what has happened to the Washington bureaus directly concerned with the industries' wartime peak programs.

The WPB Plumbing and Heating Division, which once kept more than 200 employees busy, now functions with 40. Its space, again contracted, has been moved to a small section of the Social Security Building.

The WPB Refrigeration and Air-Conditioning Section of the General Industrial Equipment Division, now employs four men and three girls. Staff included 80 at one time. The remaining seven still occupy space in the non-air-conditioned Tempo E building—an ancient stucco structure erected as a temporary building during World War I, and the only one left standing to serve through two world conflicts.

"As far as industrial refrigeration and air conditioning is concerned, it's all over but the mopping up," said Franklin B. Millham, assistant director of the GIEQ Division. "All of the orders directly affecting these industries have been revoked.

"Revocation of M-28 permits the use of Freon-12 in all types of installations; revocation of L-38 removes restrictions from the production of all types of refrigeration and air-conditioning units; revocation of L-126 removes the requirement that specified parts of certain units must be made in accordance with approved specifications, and revocation of Order L-123 permits resumption of production of air filters, air washers, industrial dust collectors; fans, blowers and exhausters, heat exchangers, high pressure blowers, pressure vessels and insulation blowing machines.

"The only direct-application order remaining in effect is P-126, which governs material for emergency servicing of commercial refrigeration and air-conditioning systems. To make this order even more effective, on June 22 the WPB announced that repairmen using the ratings assigned by CMP Regulation 9-A, or a service organization operating under Order P-126 may employ the ratings to get motors repaired, rewound or rebuilt if they are used in such household products as refrigerators, oil burners, coal stokers, etc., or in commercial refrigerating systems. These ratings may be used despite contrary provisions in Priorities Regulation No. 3, the WPB ruled in issuing Direction 5 to CMP Regulation 9A (Parts and Materials for Repairmen)."

Mopping Up Explained

Mr. Millham explained that those remaining in the Refrigeration and Air-Conditioning section will be chiefly concerned with administering WPB-authorized programs of manufacture, which include definite allocations of materials and components for fabrication during the third and fourth quarters of 1945. These include programs for military agencies and quota allocations to maintain essential civilian installations. Also to be considered by the staff, as the Pacific War progresses, will be the question of whether it will be necessary to extend civilian authorizations into later quarters, and if so, to provide necessary materials.

For any production over and above authorized schedules—and it is the policy of the WPB to limit such authorizations to levels approved during the highest quarter during which the two-front war restrictions were in effect—producers are to be "on their own" from the standpoint of locating necessary materials.

WPB contemplates that the open-ending of CMP—the freeing of all items not actually required for specific war production and authorized civilian programs—will permit the resumption of civilian production as rapidly as there is open capacity in the manufacturing plants, or, in some cases, as rapidly as there are markets for the civilian products.

In the case of industrial refrigeration and air-conditioning, both of these conditions apply. Manufacturers are still heavily engaged in war production, and the building restrictions contained in Construction Order L-41 still place strict limitations on the amount of new construction that may be started without specific WPB approval. However, since the June issue of HEATING AND VENTILATING, the Construction Order has been eased considerably, particularly with a view to permitting construction incident to reconversion. Broadest easing of restrictions is in the factory field, where annual expenditures of $25,000 for new construction or remodeling is permitted without approval. Previous maximum was $200.

In addition to easing its restrictions in designated classifications, provision has been made through Direction 5 to Order L-41 to grant special permission for new construction necessary to quick reconversion. Up to June 20, a total of 754 applications authorizing $155,000,000 in construction had been approved. A previous summary of applications, covering the period from April 1 through June 8, listed 553 applications approved, totalling nearly $140,000,000. It is of passing interest that applications from manufacturers of domestic mechanical refrigerators were second only to the automobile industry. Applications granted to 44 home refrigerator manufacturers authorized construction worth $4,750,000.

Open-Ending Spotty

While CMP provisions covering controlled materials were officially open-ended as of July 1, it is too early to tell just how much final production was made available. Indications in Washington were that there would be little steel actually released (certainly no sheet steel), but that there would be plenty of aluminum and copper and brass products. In fact, brass mill products, and aluminum in all excepting extruded shapes, were open-ended in advance of the official starting date, due to reports of surplus supplies. The open-ending means that purchasers may order and producers may deliver controlled materials (steel, copper, aluminum) without priority ratings—the producer to make deliveries only after his rated orders have been filled.

The situation in steel—particularly sheet—promises to be a disappointment to WPB planners and to those depending upon this item for civilian production. Military cutbacks indicate that limited amounts should be available immediately, but for some not-too-clear reason the cutbacks have not been reflected in any surplus of this material at the production level. Likely is the assumption that many who have required this material for war work have continued to place orders for it on wartime priority ratings, with a view to converting it to civilian production at a later date. WPB is exploring this probability and is reminding suspected offenders

that under Priorities Regulation No. 1, their acquisitions must be limited to a "minimum working inventory."

It is admitted in Washington, however, that it may be difficult to prove such violations of inventory provisions of the priorities regulations. In the meantime, CMP has been open-ended and on paper there should be plenty of steel, copper and aluminum to continue the Pacific War and to permit civilian industry to operate at a pace equalling its capacity to get under way.

Steel Capacity Phenomenal

The prediction that there will soon be more than enough steel is WPB's official report of the steel expansion program conducted during the war. Begun in 1940, the program lifted the ingot capacity of this country from 80,000,000 tons annually to 95,000,000—the 15,000,000 ton expansion alone being almost equal to the entire steel-making facilities of the British Isles. If even half of capacity were devoted to the Pacific war, the balance available for civilian production would be considerably larger than was actually used for all purposes, civilian and military, in many so-called normal pre-war years.

Final guess is that any shortage apparent during the third quarter will begin bubbling over in the fourth, with a deluge likely thereafter.

Piping Tight

Reflecting the spotty nature of current releases of production materials, the WPB Plumbing and Heating Division has found it necessary to continue in effect its Order L-79, governing distribution of plumbing and heating equipment, and Schedule IV of Order L-42, which restricts the manufacture of soil pipe to two types—"victory" and extra-heavy weight types. The division reports that stocks of heating equipment are limited, many of them subject to long delay in delivery; that cast iron soil pipe is in extremely short supply, and that cast iron pressure pipe, while in somewhat better position, is still short. Orders for the latter are increasing and no immediate relief is in sight for either type. Many construction jobs are reported as delayed because of the shortage of pipe.

Stokers Pick Up

Stoker production for the third and fourth quarters of this year are estimated at 35,000 and 45,000 respectively, as compared with 16,991 in the first quarter and an estimated 25,000 in the second. Of those produced in the first quarter, 6,332 were domestic type stokers and 10,659 were for industrial use. First quarter production was limited by lack of motors, manpower shortages and difficulty in getting gray iron castings. The supply situation for castings has eased slightly, but bearings are reported in short supply. Worm feeds for industrial sizes are available, but manufacturers report it difficult to obtain feed worms for domestic stokers.

Engineering Peace Conference

Something which engineers of export installations have long wished for has been scheduled—a conference at which representatives of the United States, Canada and Great Britain will attempt to resolve long-standing differences in Anglo-American engineering practice and standards of measurement.

The conference, to be held in Canada this fall under the direction of the Combined Production and Resources Board, will be attended by engineering authorities from the three countries, and discussions will continue about four weeks.

The importance of reaching some solution to the problem has been emphasized during the war, when it is estimated that historically-based differences in the design of screw threads alone in Britain and the United States has added at least $100,000,000 to the cost of the war. Those planning the conference hope that the basic difference involving screw threads will be only one of many solved. It is observed that the basic differences cause no embarrassment domestically, but serious difficulties develop when otherwise identical items of equipment have to be manufactured in one territory for use in another, or manufactured in two or three countries simultaneously, for common use in the field.

Efforts to parallel American and British engineering standards originated with the last war, when the screw thread problem also arose. In 1918, the Congress of the United States appointed a Screw Thread Commission to investigate. One year later, British, American and French commissions reported, but no agreement was reached. In 1926 a further attempt was made to unify British and American standards, the British proposing adoption of a basic thread angle of 57½ degrees as a compromise between that country's 55 degree and America's 60 degree angles.

The conversations were resumed in 1943 and 1944 and in addition to the thread problem, a number of additional projects were initiated. If carried forward during the Autumn conferences in Canada, they are expected to result in important savings in material, manpower and equipment.

East Gets More Oil

Some encouragement for users of fuel oil is to be found in the announcement that the country's two biggest pipelines—the 24-inch Big Inch and the 20-inch Little Big Inch—are both pumping civilian petroleum products to the Atlantic seaboard for the first time since they were placed in operation. Both have been used to move military gasoline, the Big Inch at the rate of 300,000 barrels a day, and the Little Big Inch a total of 80,000,000 barrels since it was placed in operation early last year. The Big Inch is now working on crude petroleum, with the smaller line scheduled to deliver domestic fuel oil, kerosene and civilian gasoline for the balance of the summer.

In addition to the pipeline contributions to civilian economy, a number of tankers have been added to the Gulf Coast-East Coast run.

Despite the increase in East Coast shipments, however, the overall petroleum picture warrants no enthusiasm. The change to the Pacific theater has increased the military demand for some types of petroleum products, particularly fuel oil, over amounts required for the two-front war. Reflecting this change in requirements, OPA on June 25 extended to the Midwest the restrictions on the issuance of residual fuel oil now in effect in all other rationed areas.

Beginning June 29, issuance of residual oil rations in the midwest were limited to two-thirds of normal requirements for heating purposes and to heat water. Formerly these users were given rations for full normal needs. The basic ration for users of other grades of fuel oil is about two-thirds of normal requirements.

EMPLOYMENT SERVICE FOR VETERANS

Position-wanted advertisements in HEATING AND VENTILATING are available without charge to returning veterans seeking positions in engineering capacities in heating, air conditioning, ventilation, piping and refrigeration. The advertisement should not exceed 25 words; identities will not be revealed. Address the Editor.

FUEL OIL For Heating and Steam Generation

LAWRENCE R. BABCOCK

Manager, Field Engineering Division,

Petroleum Heat and Power Company,

Stamford, Conn.

HEATING AND VENTILATING'S REFERENCE SECTION

Fuel Oil for Heating and Steam Generation

LAWRENCE R. BABCOCK
Manager, Field Engineering Division, Petroleum Heat and Power Co., Stamford, Conn

FUEL oil has many uses including the firing of a wide variety of boilers, furnaces and ovens. It is used as the fuel on steamships, in central power plants, in steel mills, brick kilns, ceramic kilns, cement manufacturing plants, bakeries and numerous other industries. Fuel oil is also burned in cylinders of diesel engines which provide marine propulsion, drive locomotives and motor trucks, pump water and generate electricity.

The most common use of fuel oil is for firing boilers used in heating and steam generating. It is apparent that the scope of this article must necessarily be limited because fuel oil uses are too broad and too varied to be covered herein. It is the intent to confine it to the use of fuel oil as applied to the firing of heating and power boilers usually found in the ordinary type of commercial and industrial buildings. It does not include oil burning as applied to the heating of houses or, on the other hand, the large central heating or central power stations.

The field of application under consideration is the industrial type oil burners used in office and apartment buildings, in theatres, hotels, stores, hospitals, schools, laundries, and manufacturing plants. Boiler rooms in these buildings will be more or less typical, containing from one to three boilers from 30 to 300 boiler horsepower. Fire tube boilers will predominate although water tube boilers will be found in many of the larger plants where the individual boiler size is 200 boiler horsepower or more. Steam pressures will range from 2 up to 15 lb per sq in., in the case of the low pressure heating plants and up to 150 lb per sq in., in the majority of these plants where steam is used for driving electric generators, industrial processes, laundry work, sterilizing or cooking. There will be some exceptions, of course, but in general the boiler plants will fall within these limits.

Reasons for burning oil in preference to other fuels are a matter of economics. Industrial burners are purchased for entirely different facts than small burners for the home. The one is a practical utility, the other a convenience and comfort. In commerce and industry an oil burning system is provided only if it can show a greater profit in business. The oil burner must pay its own way in one form or another, since coal, the chief competitor of oil, always has been and probably always will be a reliable fuel and an economical one when used with intelligent firing and proper equipment. This does not mean that oil must be lower priced on a basis of comparative heat content for there are other factors which must be studied and weighed.

The four prime factors in estimating the economies of a proposed oil burning system are: The unit cost of the competitive fuel, the unit cost of oil, the relative efficiencies at which the two fuels are burned, and the labor needed with either method of firing.

After these four factors are established, the indirect savings may be estimated and the total savings obtained. None of these figures is difficult to determine excepting that of the relative operating efficiencies. It is on the determination of this latter point that the successful estimating of fuel costs results.

If a complete evaporation test and heat balance could be run on every prospective oil burner installation to establish its actual operating efficiency with the competitive fuel, then the estimating of the fuel consumption and fuel savings would be simple. Evaporation tests are usually out of the question for prospective jobs of the average size due to the expense of conducting such a test. Large plants equipped with recording flow meters and recording combustion instruments have a day to day record of their actual operating efficiency. However, the medium sized plants under discussion are seldom equipped with recording meters. The more modern of the medium sized plants are trending to the use of instruments. This will be found in the high pressure manufacturing plants to a far greater extent than in the low pressure heating plants.

It is possible for an experienced combustion engineer to go into a plant and by using a hand operated Orsat, determine the analysis of the flue gases over a period of time. The flue gas analysis with frequent readings taken under all firing conditions will indicate the combustion

WEIGHT PER POUND OF OIL PER POUND		REQUIRED POUNDS		PRODUCTS OF COMBUSTION POUNDS PER POUNDS OF OIL				
		AIR	O_2	CO_2	O_2	H_2O	SO_2	N_2
C	0.842	9.703	2.246	3.088				7.457
H_2	0.131	4.527	1.048			1.179		3.479
O_2	0.012				0.012			
S	0.004	0.017	0.004				0.008	0.013
N_2	0.011							0.011
TOTAL WEIGHT	1.000	14.247	3.298	3.088	0.012	1.179	0.008	10.960
O_2 IN THE OIL		-.052*	-.012		-.012			-.040*
		14.195	3.286	3.088	0.000	1.179	0.008	10.920
SO_2 AS CO_2				+.008			-.008	
		14.195	3.286	3.096	0.000	1.179	0.000	10.920

* ALLOWANCE FOR AIR EQUIVALENTS OF O_2 IN OIL

Fig. 1. Weight of products resulting from burning one pound of oil, perfect combustion, with an ultimate analysis by weight—carbon 84.27%, hydrogen 13.1%, oxygen, 1.2%, sulfur 0.4%, and nitrogen 1.1%.

efficiency. A flue gas thermometer inserted in the smoke breeching close to the boiler will be required to show the temperature of the gases leaving the boiler. A portable draft gauge should be used to indicate the draft over the fire and at the boiler smoke outlet. Data collected in this manner, together with information on the amount of fuel burned, will enable the combustion engineer to draw some fairly accurate conclusions as to the plant's average operating efficiency and what could be expected if oil burners are installed. This method of arriving at efficiency is not too expensive and is accurate enough for all practical purposes.

Indirect savings in burning oil usually result from cleaner operating conditions. This is particularly important to laundries, dry cleaning establishments and dairies. Some laundry operators are willing to use oil even at an increase in fuel cost in order to have this benefit.

Another indirect savings may result from increased utilization of floor space. Oil fuel stored in an outside tank buried in the ground permits turning a coal bunker into useful storage space.

Lower maintenance costs usually result from the installation of oil burning equipment. There is no maintenance cost of conveying or fuel handling equipment. Ash removal expense is eliminated. While this may be of no appreciable importance at some plants, it does run into a sizable item at others. It warrants investigation and consideration.

CHARACTERISTICS OF FUEL OILS

The term fuel oil is generally understood to include all grades of oil used for fuel purposes. It may include kerosene, the distillates, the residuals and even crude oil. Fuel oils are frequently referred to as light oils and heavy oils. The light oils are understood to be the distillates used for residential heating and the heavy oils are the residuals used for industrial burning. The terms "light oil" and "heavy oil" go back to the time when it was customary to specify or purchase oils on the basis of their gravity. Unfortunately the Baumé gravity of a fuel oil proved to be no indication of the quality or burning characteristics. Various types of oil burners required an oil of certain known qualities, and this was particularly true for the domestic oil burners installed in homes. The natural outcome of this situation was the development and adoption of standard specifications.

In any discussion of fuel oils there will be frequent reference to certain characteristics which should be understood and which may be briefly identified as follows:

Gravity is the weight or density of an oil. A physicist by the name of Baumé developed a hydrometer or weighted glass float with a graduated stem to measure the density of liquids. The depth at which this instrument floats in the oil indicates the gravity in degrees Baumé. The Baumé gravity of water at 60F is 10 degrees. The range for fuel oil is approximately 10° for the heavy oils to 40° for the light oils.

Viscosity of an oil is the measure of its resistance to flow. It is expressed as the number of seconds required for a measured quantity to flow through a standard opening at a standard temperature. The viscosity indicates whether the oil will flow freely through the pipes, valves and burner, and how easily it can be atomized for burning. A low viscosity figure is desirable, when combined with other satisfactory quali-

TABLE 1.—DETAILED REQUIREMENTS FOR FUEL OILS[1]

Grade[2]		Flash Point F		Pour Point F	Water and Sediment, %	Carbon Residue, %	Ash, %	Distillation Temperatures, F				Viscosity Seconds			
								10% Point	90% Point		End Point	Saybolt Universal (At 100F)		Saybolt Furol (At 122F)	
Number	Description of Fuel Oil	Min.	Max.	Max.	Max.	Max.	Max.	Max.	Max.	Min.	Max.	Max.	Min.	Max.	Min.
1	Distillate oil for use in burners requiring a volatile fuel	100 or legal	165	0	Trace	0.05 on 10% residuum[4]		410			[5]560				
2	Distillate oil for use in burners requiring a moderately volatile fuel	110 or legal	190	[3]10	0.05	.25 on 10% residuum[6]		440	600						
4	Distillate oil for use in burners requiring a low-viscosity fuel	110 or legal	230	[3]20	.10	.15 straight			675	[7]600		45			
5	Oil for use in burners requiring a medium viscosity fuel	130 or legal			1.00		0.10						50	40	
6	Oil for use in burners equipped with pre-heaters, permitting a high viscosity fuel	150			[8]2.00									300	45

[1]Recognizing the necessity for low-sulfur fuel oils used in connection with heat treatment, nonferrous metal, glass and ceramic furnaces, and other special uses, a sulfur requirement may be specified in accordance with the following table:

Grade of Fuel Oil, Number	Sulfur (Maximum) %
1	0.5
2	.5
4	.75
5	No limit
6	No limit

[2]Other sulfur limits may be specified only by mutual agreement between the buyer and seller.

[3]It is the intent of these classifications that failure to meet any requirement of a given grade does not automatically place an oil in the next lower grade unless in fact it meets all requirements of the lower grade.

[4]Lower or higher pour points may be specified whenever required by conditions of storage or use. However, these specifications shall not require a pour point lower than 0F under any conditions.

[5]For use in other than sleeve-type blue-flame burners, carbon residue on 10% residuum may be increased to a maximum of 0.12%. This limit may be specified by mutual agreement between the buyer and seller.

[6]The maximum end point may be increased to 590F when used in burners other than sleeve-type blue-flame burners.

[7]To meet certain burner requirements, the carbon-residue limit may be reduced to 0.15% on 10% residuum.

[8]The minimum distillation temperature of 600F for 90% may be waived if API gravity is 26 or lower.

[9]Water by distillation, plus sediment by extraction. Sum, maximum 2.0%. The maximum sediment by extraction shall not exceed 0.50%. A deduction in quantity shall be made for all water and sediment in excess of 1.0%.

fications, and is one of the most important factors in judging a fuel oil. The viscosity of a fuel oil decreases with an increase in temperature and increases with a drop in temperature.

Flash Point is the temperature to which an oil must be heated in order to give off the quantity of vapor required to provide an inflammable mixture with air. It seems to indicate the ease of ignition of the fuel.

Pour Point is the temperature at which the oil fails to flow due to coldness. Pour points are specified in order to obtain a fuel oil which can be pumped at the lowest temperature to which it will normally be subjected.

Distillation Range and End Point indicate at what temperatures and how uniformly the oil will vaporize. This test is used only in connection with the distillate oils. It shows whether the oil is of uniform composition or composed of light and heavy parts. It has much to do with clean burning, ease of ignition and freedom from soot and carbon.

Water and Sediment are impurities which are almost entirely excluded in the distillate oils but which are permitted in very small percentages in the residual oils.

Carbon Residue is the amount of residue left after evaporating a measured quantity of oil under specified conditions. It is used to determine the probable carbon forming tendency of an oil.

These characteristics taken singly have little meaning as regards the quality of a fuel oil. They have a definite value when taken collectively.

The Department of Commerce has published a bulletin containing the standard specifications pertaining to the five grades of fuel oils which are in common use. This bulletin, Commercial Standard CS12-40, specifies the characteristic requirements for each of the five grades. Table 1 is taken from that bulletin.

These standard classified grades of fuel oil are the products of distilling crude oil. The distillation process is a long and complicated one. Basically it consists of boiling the crude oil in a still and condensing the vapors as they come over to the receiving tanks. The products being refined release their vapors at different boiling points. The light benzines containing naphtha and gasoline are released first, followed by the kerosenes, and then the distillate fuel oils and heavier products. These distilled products are then further processed to improve and standardize their qualities.

Residue in the still furnishes other products which may include lubricants, waxes, tar and it is from this residue that the residual fuel oils are obtained.

Distilled or domestic fuel oils are used primarily for residential heating and the smaller sizes of commercial buildings. They are also used industrially for firing heat treating furnaces, forges, core ovens, bake ovens and numerous other process applications.

Distillate oils of 1, 2 and 3 grades are required to suit the needs of various types of domestic burners. Vaporizing and pot type burners usually require a No. 1 grade. The vertical rotary type of domestic burner usually needs a No. 2 grade. The popular gun type electric ignition burner burns No. 3 oil or any of the lighter oils. No. 3 oil is sometimes used with the industrial burners in those localities where the residual or industrial fuel oils are not available.

No. 5 and No. 6 residual oils are used primarily for heating and steam generation in the commercial and industrial field.

These residual oils are very viscous and specifications permit a wide range of viscosity. The No. 6 oil, also called Bunker C oil, has to be heated before it can be pumped and atomized. The application of heat "thins out" the oil or reduces its viscosity so that it becomes relatively free-flowing. No. 5 oil is less viscous than No. 6 oil. No. 5 oil may or may not require heating, depending on the type of oil burner and actual viscosity of the oil. Some of the industrial rotary cup type oil burners can burn No. 5 oil without preheating providing the No. 5 oil delivered has an actual viscosity which will permit flow and atomization at ordinary room temperatures.

Heat content of a fuel oil varies to a small extent with its gravity. A heavy fuel oil has more Btu per gallon than a light oil. Average heat values are as follows:

Commercial Standard Grade, No.	Approx. Gravity Range, Baume	Heat Content Btu per Gallon
1	38-40	136,000
2	34-36	138,500
3	28-32	141,000
5	18-22	148,000
6	14-16	151,000

COMBUSTION OF FUEL OIL

A knowledge of combustion is essential to anyone engaged in the design of oil burning systems or in designing the refractory firebox or combustion chamber for a specific type and size of boiler. It is an interesting subject and there should be a more general understanding of the basic principles than appears to be prevalent. Combustion is definitely a technical subject but it does not need to be excessively so in order to be presented in a manner that will make a knowledge of it a useful tool.

Combustion can be defined as a chemical reaction between combustible elements and oxygen during which there is liberated a quantity of heat.

The heat liberated is the useful result of combustion. The chemical reaction between the combustible elements and oxygen is a necessary process required to produce the heat.

A combustible element is any element which will unite with oxygen to produce heat. The speed with which combustion takes place depends upon the affinity of the combustible for oxygen and certain conditions under

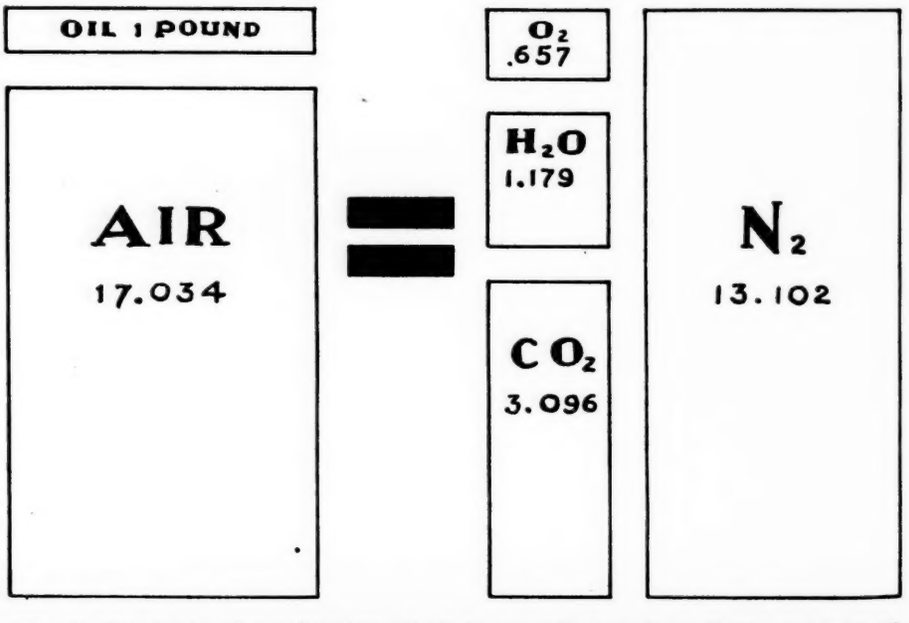


Fig. 2. Products of combustion of oil in pounds based on Orsat reading of 12.5% CO_2 by volume in flue gas.

which combustion occurs. The mere presence of the combustible and oxygen will not result in combustion. Every combustible substance must be raised to a certain temperature in the presence of oxygen before it will burn. This temperature is designated as the ignition temperature. The ignition temperature is then that temperature at which a combustible substance will ignite and continue to burn in the presence of oxygen. Ignition temperatures of the substances found in the combustion of fuel oil are as follows:

Carbon	C	925F.
Hydrogen	H_2	1130F.
Sulfur	S	470F.
Carbon Monoxide	CO	1210F.

This explains why it is necessary to use a torch or gas pilot to ignite an oil burner. The heat of an electric spark will ignite the light distillate fuel oils but is not sufficient to ignite the heavy residual fuel oils as atomized by a horizontal rotary cup type oil burner.

Oxygen required to support combustion is found in the air. It is important to understand that oxygen supports combustion but is not a combustible. It unites with the combustible during combustion to produce the products of combustion commonly referred to as flue gas.

Air is a mixture (and not united as a compound) of oxygen and nitrogen. The proportions of oxygen and nitrogen are

	% by Volume	% by Weight
Oxygen (O_2)	20.91	23.15
Nitrogen (N_2)	79.09	76.85

Oxygen has a strong affinity for the combustible element of the fuel and readily enters into chemical union with those elements under the condition that the combustible elements are maintained at or above their respective ignition temperatures.

While nitrogen in air serves no useful purpose in the process of combustion, its presence results in an unavoidable loss. Nitrogen does not enter into any union with the combustible elements. It enters and passes through the furnace and boiler and up the stack without change. It does absorb useful heat and gives up only a portion of that heat before making its exit from the boiler. Heat not extracted from the nitrogen is lost. Since there is almost four times as much nitrogen present as oxygen, this loss is an appreciable but an unavoidable one.

It is now necessary to consider the constituents of fuel oil. Fuel oil is composed of approximately 85% carbon, 13% hydrogen, and 2% oxygen, sulfur and nitrogen. A representative analysis of a fuel oil is as follows:

Ultimate Analysis by Weight

Carbon	C	84.2%
Hydrogen	H_2	13.1
Oxygen	O_2	1.2
Sulfur	S	0.4
Nitrogen	N_2	1.1
		100.0%

The furnace or combustion chamber is the retort in which the chemical union of the various elements in the fuel oil unite with the oxygen of the air to form the products of combustion. It is during this formation of products that the heat is liberated. The furnace is usually constructed of refractory bricks or plastic refractory. Its purpose is to absorb and maintain a high temperature well above the ignition temperatures of the combustible elements so that combustion will be rapid *and complete.*

Fuel oil is atomized by the oil burner by breaking up the oil into a mist of fine particles which are then projected into the furnace. The mist-like spray is almost immediately vaporized by the heat of the furnace. Air is introduced into the furnace in such a manner as to come into intimate contact with the atomized oil and oil vapor. Since the furnace temperature is maintained well above the ignition point of the combustible elements, combustion takes place and the oil is burned in suspension. Burning of the fuel oil results in a flame, the color of which is an indication of the degree of completeness of combustion. This guide, however, is an unreliable one and should not be depended on.

A combustion test device, known as an Orsat, should be used to determine the proper ratio of air admission to the amount of fuel oil. Air is usually introduced by the natural draft of the furnace. Where the stack is inadequate to induce the necessary amount of air, a forced draft fan is used to push air into the furnace under a very slight pressure or an induced draft fan may be installed between the boiler smoke outlet and the stack to increase the suction required to suck air into the furnace.

What happens in the furnace is briefly this — the carbon in the fuel oil unites with the oxygen in the air to form carbon dioxide ($C + O_2 = CO_2$). In the case of a deficiency of air or improper mixing of air and oil, it is possible to get carbon monoxide ($2C + O_2 = 2CO$). However, the affinity of carbon for oxygen is such that carbon dioxide will form and even if carbon monoxide is present, it will, upon further contact with oxygen under furnace temperatures, go to carbon dioxide ($2CO + O_2 = 2CO_2$). Carbon monoxide is formed but rarely in a well designed furnace with a properly adjusted oil burner.

Hydrogen in the oil burns or unites with the oxygen to form water vapor. This water vapor passes through the boiler and up the stack in the form of superheated steam. It is seldom apparent to the eye except in subzero weather when it may condense as it emerges from the top of the stack in a noticeable white vapor ($2H + O_2 = 2H_2O$).

Sulfur in the oil burns or unites with the oxygen to form sulfur dioxide. The quantity is almost negligible as compared with the quantity of the other gases. ($S + O_2 = SO_2$)

Oxygen and nitrogen content found in fuel oil serves the same purpose as oxygen in the air. Oxygen in the oil unites with the carbon, hydrogen and sulfur. The liberated nitrogen simply absorbs heat, gives up a portion of that heat in passing through the boiler, and passes out through the stack.

It is apparent that oxygen in the air serves a necessary and useful purpose, whereas the nitrogen serves no useful purpose and does carry away heat from the boiler.

PRODUCTS OF COMBUSTION

Perfect combustion is a theoretical rather than practical condition which is interesting to consider. Perfect combustion would result when there is no excess amount of air present and the fuel is completely consumed. In practice it is impossible to operate with perfect combustion. Some excess air is necessary. The furnace conditions would be too critical if only the amount of air required to burn the fuel was admitted into the furnace. It would be found that instead of perfect combustion, there would be smoke as well as soot deposit on the boiler surfaces and also some carbon monoxide present in the flue gas. In practice it is necessary to operate with a certain amount of excess air.

Fig. 1 shows the weight of each product of combustion based on burning one pound of the fuel oil having the ultimate analysis given previously. Note that the total weight of the products is exactly equal to the weight of one pound of oil plus the pounds of air required for perfect combustion. Also note that the sulfur content is infinitesimal as compared with the other products. The sulfur dioxide is finally transferred to the CO_2 column for the reason that its presence could not be detected with the Orsat and would be included in the CO_2 reading. It is included in the table more for accuracy than for any practical reason.

Referring to the table, it is interesting to note that when burning one pound of fuel oil, there is more than one pound of water vapor formed.

TABLE 2.

Weight of Products — Perfect Combustion		Weight of Products—Varying Amounts of Excess Air—Pounds				
		20%	40%	60%	80%	100%
CO_2	3.096	3.096	3.096	3.096	3.096	3.096
O_2	0.000	0.657	1.314	1.972	2.629	3.286
N_2	10.920	13.102	15.284	17.465	19.647	21.829
H_2O	1.179	1.179	1.179	1.179	1.179	1.179
Total Weight	15.195	18.034	20.873	23.712	26.551	29.390

For every gallon of fuel oil burned, approximately one gallon of water goes up the stack in the form of superheated steam and which is invisible to the eye. Also, note that 14.2 lb of air or 190 cu ft of air at 70F are required for each pound of oil. In practice this air quantity is greater.

It has already been stated that an excess amount of air is necessary in the practical burning of oil. It is desirable to keep this amount of excess air at a minimum. The amount of excess air has a direct bearing on boiler efficiency and, of course, on fuel economy.

Table 2 shows the *weight* of the products of combustion with varying amounts of excess air. Note that the weight of burned products of the carbon and hydrogen are constant and that the weight of the unburned products increases rapidly as the amount of excess air is increased.

Flue Gas Analysis

Flue gas analysis is necessary to determine combustion efficiency. The Orsat which is used for making this determination is a portable apparatus comparatively simple to operate. Flue gas samples are pumped from a sampling tube inserted in the smoke breeching and then pass through rubber tubing into the Orsat. The Orsat traps a known volume (100 cubic centimeters) of flue gas which is successively exposed to three chemicals. The first chemical absorbs the carbon dioxide (CO_2), and the amount of absorption can be read on a percentage scale. The second chemical absorbs the excess oxygen (O_2) and the third absorbs the carbon monoxide (CO) if any is present. The Orsat analysis shows the dry products of combustion only. The water vapor, being condensed, does not show up in the gas analysis. The flue gas analysis as determined by the Orsat is on a volumetric basis. Table 3 shows the percentages of the various dry gases with varying amounts of excess air in the flue gas, on the volumetric basis. Note that the percent of CO_2 decreases as the amount of excess air increases. It is important to understand that the volume of CO_2 in the flue gas indicates the amount of excess air present and the combustion efficiency

The larger and better operated boiler plants have CO_2 recorders which are a mechanical type of Orsat. These take flue gas samples at regular frequent intervals and record the percentage of CO_2 in the flue gas on a time chart.

The following percentages are a guide to boiler operation when burning oil:

Excellent performance	12 to 13.5%	CO_2
Good performance	10 to 12%	CO_2
Fair performance	8 to 10%	CO_2
Poor performance	Below 8%	CO_2

It is not advisable to try for more than 13½% CO_2 in the flue gas. One very good reason is that the furnace refractories may not last as long as with a little more excess air and somewhat lower CO_2. This is particularly true when boilers are being fired at high ratings.

Stack Temperatures

A flue gas thermometer is required to determine the temperature of the gases leaving the boiler. A portable test thermometer is frequently used. It is an ordinary mercury type thermometer protected from breakage by a metal armor and is calibrated up to 1000F. The thermometer is inserted through a round hole in the breeching and the space between the rim of the hole and the thermometer should be sealed with asbestos. Otherwise air infiltration around the thermometer may cause a false reading. The stack temperature of the exit gases is required, along with other data, to determine the efficiency of the boiler.

It is well at this time to call attention to the fact that combustion efficiency is a separate and distinct item from boiler efficiency. Combustion efficiency is determined by the flue gas analysis and can be calculated from the volumetric percentage of CO_2 in the flue gas.

Boiler efficiency is determined by the ratio of the amount of heat absorbed by the boiler to the amount of heat liberated in the furnace. Boiler efficiency is affected by the degree of cleanliness of the boiler surfaces, the amount of air infiltration through cracks in poor fitting doors or leaks in the setting, the rate at which the boiler is being fired and also, the design of the boiler itself.

It will be found that the stack temperature will vary to some extent as the percentage of CO_2 in the flue gas varies. This statement is based on no change being made in the quantity of fuel oil being consumed. The stack temperature will increase as the CO_2 decreases. This is explained by the increased quantity of hot gases leaving the boiler with the lower CO_2. It is, of course, understood that the stack temperature will increase or decrease as the firing rate increases or decreases.

Draft

The draft created by the stack or draft fans is required for two purposes:

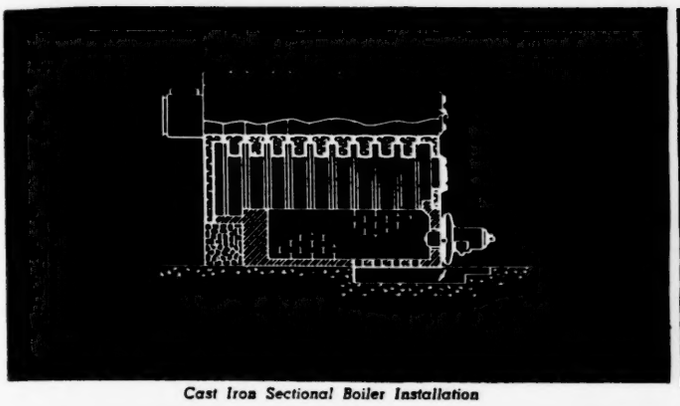
1. To induce air into the furnace to support combustion.
2. To remove the products of combustion from the boiler as fast as they are created.

Too strong a draft will induce too much air and result in low CO_2 or, in other words, too great a quantity of excess air.

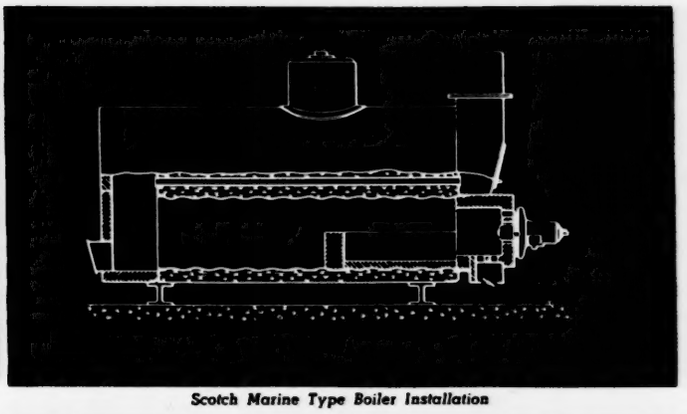
Insufficient draft will not admit sufficient air to burn the necessary amount of fuel and will cause smoke and soot deposit in the boiler or it will make it necessary to reduce the firing rate to suit the draft condition with corresponding loss in boiler capacity.

TABLE 3.

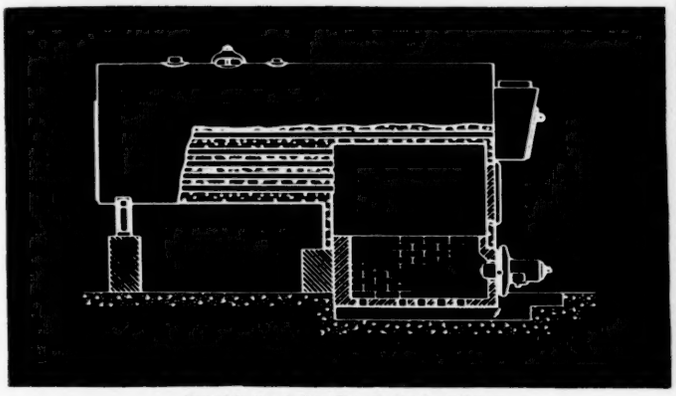
Per Cent of Volume of Dry Gases — Perfect Combustion		Per Cent of Volume of Dry Gases—Varying Amounts of Excess Air				
		20%	40%	60%	80%	100%
CO_2	15.2	12.5	10.6	9.3	8.2	7.4
CO	00.0	00.0	00.0	00.0	00.0	00.0
O_2	00.0	3.7	6.3	8.1	9.6	10.8
N_2	84.8	83.8	83.1	82.6	82.2	81.8
Total	100.0	100.0	100.0	100.0	100.0	100.0



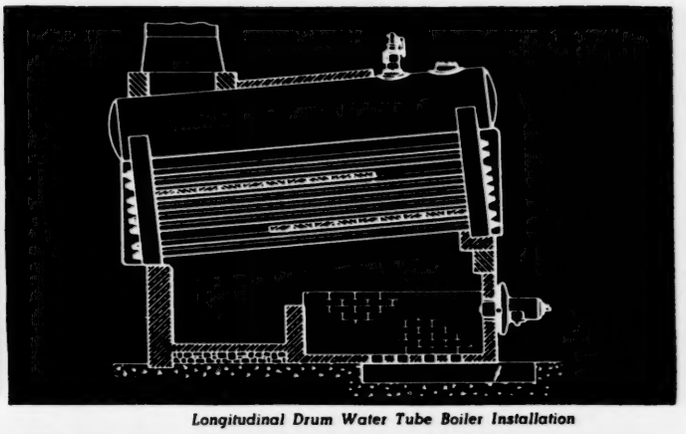
Cast Iron Sectional Boiler Installation



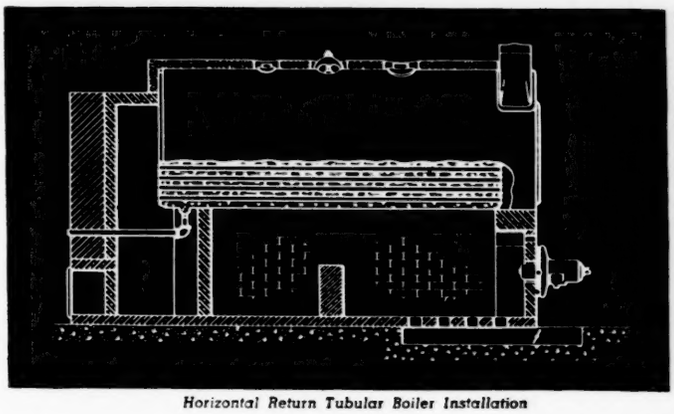
Scotch Marine Type Boiler Installation



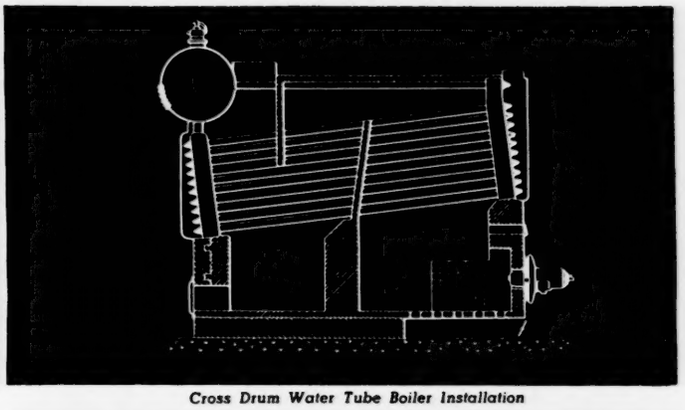
Portable Steel Fire Box Boiler Installation



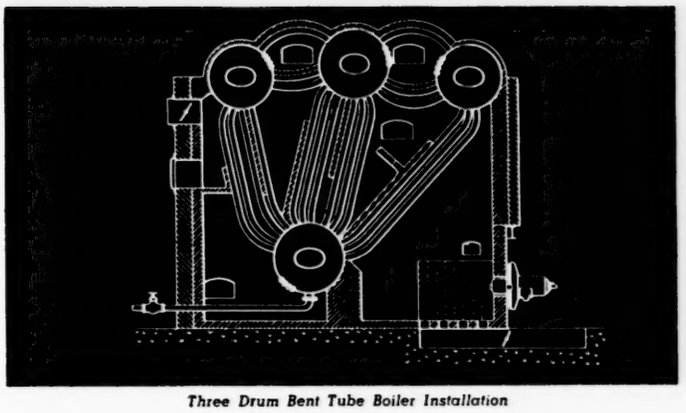
Longitudinal Drum Water Tube Boiler Installation



Horizontal Return Tubular Boiler Installation



Cross Drum Water Tube Boiler Installation



Three Drum Bent Tube Boiler Installation

Fig. 3. Some of the more common types of boilers used in industry.

The boiler manufacturer's catalog usually specifies the diameter and height of the stack for each particular boiler. When this specification is adhered to, there will be no difficulty with insufficient draft.

Draft intensity is measured by a draft gauge. There are various types, the simplest of which is the liquid portable gauge used for test work. Draft gauges show the draft intensity measured in hundredths of an inch of water column.

Draft readings are taken of the draft intensity in the furnace and at the boiler smoke outlet. The difference between these two readings is the draft loss through the boiler. The draft loss through the boiler increases as the firing rate or output of the boiler is increased.

Draft readings at both places are important but in setting the firing rate of the oil burner, the furnace draft is the more important. The draft should be regulated by the outlet damper or draft controller until no more air is admitted than is required for the quantity of fuel oil. Another point in favor of keeping the draft as low as possible and yet consistent with good burner operation is that the velocity of the gases pass-

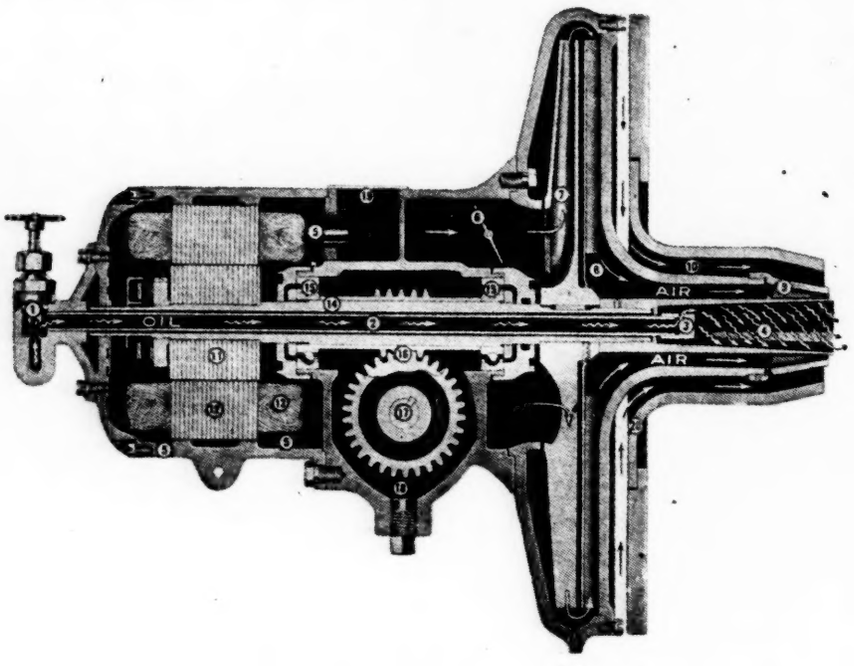


Fig. 4. General sectional view of a horizontal rotary cup oil burner.

ing through the boiler is slowed down, thereby allowing the hot gases more time to give up the greatest amount of heat before passing out of the boiler.

The Orsat, stack thermometer and draft gauge are all necessary tools to be used in determining the performance of oil burners. Without these instruments, the adjustments are only guesswork. The installation of a CO_2 recorder with recording stack temperature and draft gauges, particularly in the larger plants, will permit intelligent firing of the oil burners and getting the greatest amount of steam from the least amount of fuel.

TYPES OF OIL BURNERS

The oil burner prepares the fuel oil for burning by atomizing or by vaporizing the oil. Vaporizing type oil burners do not come within the scope of this article and will not be considered herein. The atomizing type of oil burners break the oil up into a fine mist-like controlled spray and direct that spray into the hot refractory lined combustion chamber. The heat of the combustion chamber causes the fine spray particles to vaporize and the vapors ignite and burn. Consider only one of these small particles. It is projected into the combustion chamber and due to the high temperature, immediately starts to give off vapors. The vapors ignite and burn until the particle is completely vaporized and consumed. This process takes place before the atomized particle traverses the length of the combustion chamber.

Methods of Atomization

Atomization can be effected in a variety of ways. Considered for boiler application in boilers to 300 hp, the most common types of oil burners are:

1. The horizontal rotary cup type oil burner.
2. The mechanical type oil burner.
3. The steam atomizing oil burner.

Horizontal Burner

The horizontal rotary cup oil burner has been and is the leading type within the past fifteen years. There are many reasons for this. The principal one being that it is a self-contained integral unit. In its most common form it is made up of a motor, fan, fuel oil pump, atomizing cup and air nozzle. The motor, fan and atomizing cup operate at speeds of 3,450 rpm, in the case of 60-cycle current with direct drive, or the speed may be increased by using a belt drive arrangement. The design and construction varies with the different manufacturers. Figs. 4 and 5 are more or less typical.

It is readily adaptable to manual, semi-automatic or full automatic control.

The tendency of recent years has been increasingly in favor of full automatic control.

It has a wide firing range within the limits of its rated capacity.

Its operating and maintenance costs are reasonably low. It will burn light oils not requiring preheating, or the heavy industrial fuel oils preheated, with equal and satisfactory results.

It lends itself to a simple and economical installation because it is a compact and self-contained unit. As with all types of burners, the installation for burning heavy oils is more expensive because of the oil heating apparatus and, of course, the type of control desired also has a bearing on the installation costs.

A few rotary cup burners are so constructed, Fig. 6, that the spinning cup is actuated by an integral air driven turbine in place of the more common electric motor drive.

The principle of atomization is the same on all horizontal rotary burners. Oil under low pressure is fed to the inside of the atomizing cup. The oil forms a film on the inner surface. The centrifugal action of the cup causes the film to flow to the rim where it is broken up and thrown off at high velocity. Air from the fan is directed to and through the stationary air nozzle surrounding the cup. The blast of air through the nozzle assists in atomization and directs the atomized oil into the furnace.

Air supplied by the fan and designated as primary air is only a small percentage of the air required to support combustion, usually about 15%. The remainder or secondary air which is induced into the furnace by the natural draft is admitted through a damper controlled opening below the burner. It may or may not be distributed through checkerwork openings in the furnace floor.

Mechanical Oil Burner

The mechanical burner is not well named as it is the least mechanical of any burner and has no moving parts in the burner. Oil is atomized by subjecting it to a relatively high pressure (100 to 225 lb per sq in.) and passing it through a specially designed nozzle. Basically the nozzle is made up of a steel atomizing disc, a swirl chamber and discharge orifice. The oil under pressure passes through the fuel tube of the burner assembly to the nozzle. On entering the nozzle the oil is forced through the atomizing disc. This disc has three or more tangential slots so arranged as to impart a rapid swirling motion to the oil. The oil passes out of the tangential slots and swirls around in the swirl chamber and is then forced out through the discharge orifice into the furnace. Oil is broken into a fine, regular, controlled spray on leaving the atomizer as a result of the combination of centrifugal action and sudden pressure drop. All air required to support combustion with this type of burner is admitted through the air register, which is always used in combination with this burner. Air volume is controlled by a suitable shutter arrangement, and directional vanes are incorporated in the register to set up a rotating motion to the air as it passes through to the furnace. This effects a more

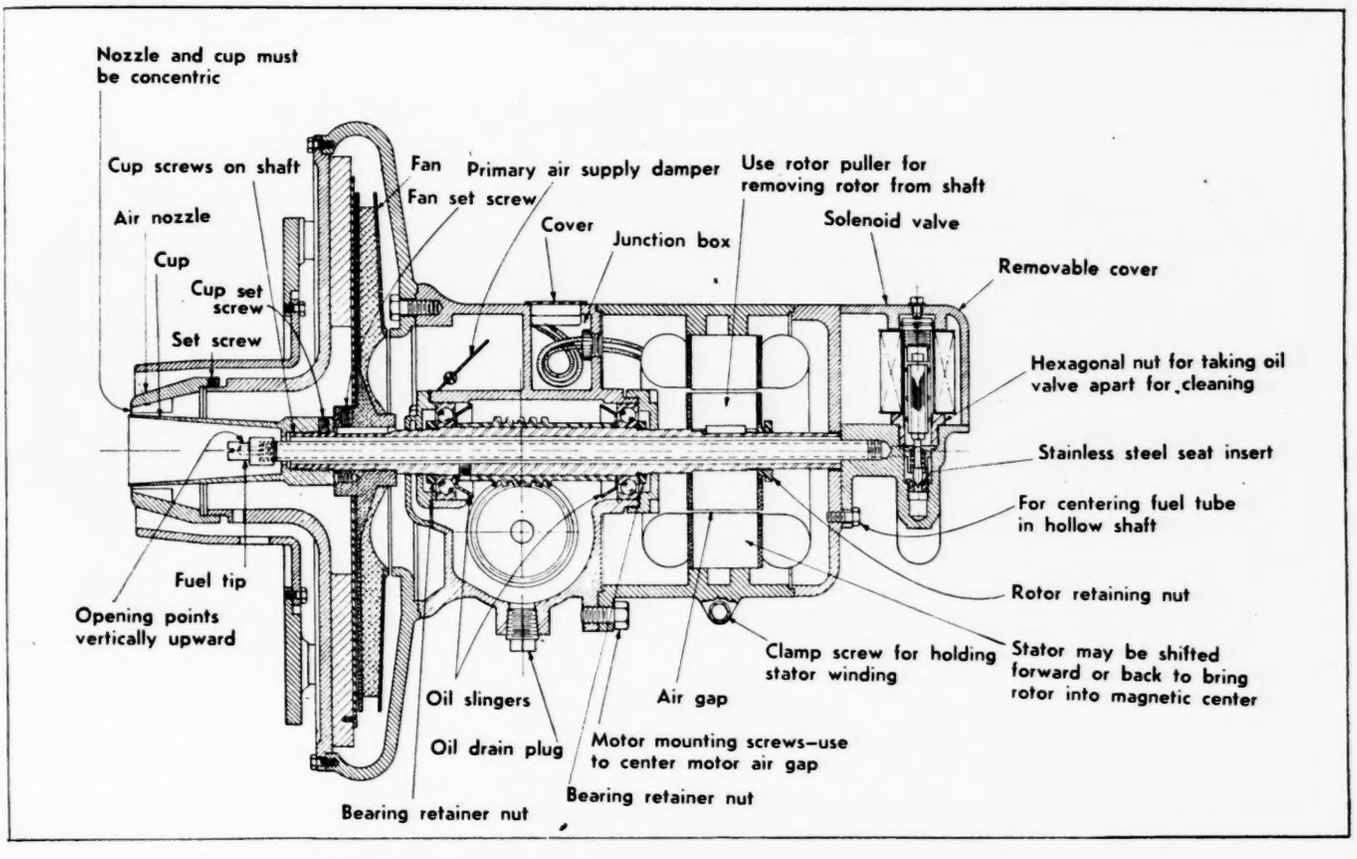


Fig. 5. General construction features of a direct drive oil burner.

intimate mixture of the air and atomized oil. See Fig. 7.

Fuel oil must be maintained at a lower viscosity for atomizing with the mechanical burner than with the horizontal rotary. Therefore, the oil must be heated to higher temperatures. Since oil must also be maintained at high pressures, careful straining of the fuel oil is necessary. The usual coarse strainers are installed in the suction lines to protect the pumps. Oil is again strained after leaving the pump and heater, by passing through a fine mesh strainer located in the oil discharge piping. A third and small strainer is usually found in the burner assembly. This multiple straining of the oil is necessary to keep the nozzle from getting clogged. It is necessary to change and clean burners two or three times daily.

The piping system, including pumps and heaters, must be designed for at least 250 lb working pressure and the heaters capable of heating the oil up to 250F.

Nozzles are rated to deliver a certain quantity of fuel oil at a stated fixed pressure. Capacity may be varied to some extent by varying oil pressure. There are some wide capacity range burners of special design. The nozzles are a very fine piece of machine work and should be handled and cleaned carefully in accordance with manufacturer's instructions.

Mechanical burner capacity is limited by the air capacity of its register. These registers are suitable for either natural or forced draft. With natural draft the capacity depends on the furnace draft intensity to induce air through the register as well as through the area of the air opening in the register. With forced draft the capacity of a single burner and register can be approximately doubled.

The mechanical burner is not competitive to any appreciable extent with the horizontal rotary cup type burner. The horizontal rotary is suitable for boilers ranging from 30 up to 300 hp nominal rating and in general, for capacities up to 150% of these ratings. Mechanical burners are seldom applied to boilers under 250 hp and the majority of these are water tube boilers with forced draft fans for capacities up to 200% or more of nominal rating. Mechanical burners are usually installed in multiple numbers, two, or three or more burners being applied to a single boiler and they can be considered as best suited to the larger boiler plants equipped with water tube boilers, operated at high ratings, with forced draft. These burners are well adapted for use with semi-automatic control but are not available for fully automatic operation. Mechanical burners are the accepted type for marine use.

Steam Atomizing Burners

Steam atomizing burners have been in use for many years. They are simple, reliable and the installation cost is relatively low. At one time the steam atomizer was a leader in the field. There has been a gradual decline in the use of steam atomizing burners although recently there has been a noticeable trend back to the use of this type.

Steam atomizing burners are classified into two groups—inside mixing or outside mixing. This refers to the steam and oil being mixed inside the burner or at the burner orifice. The inside mixer is most commonly used and further discussion refers only to the inside mixer.

The inside mixing burners are simple in design and there are no moving parts. The orifices are of sufficient size so that there is little or no trouble with clogging. The mixing chamber is located ahead of the steam jets and it is here that the steam atomizes the oil before it is forced through the orifice into the combustion chamber.

These burners are readily adapted to semi-automatic operation under control of a steam pressure actuated governor which regulates the flow of oil and steam entering the burner.

Oil is delivered in the burner at pressures ranging from 10 to 50 lb per sq in. Steam is delivered to the governor at boiler pressure. High pressure steam is necessary and steam pressures from 30 to 100 lb are commonly employed.

A well designed steam atomizer will use only from 1½ to 2% of the total steam generated for atomizing purposes. It is possible that steam consumption will exceed these figures if the fireman is careless maintaining a proper ratio of steam to oil.

Steam atomizers will provide a flat flame, Fig. 8, or a round flame, Fig. 9, depending upon the design of the tip. Flat flame burners are installed with the air admitted through checkerwork ports in the combustion chamber floor. Very little clearance is required between the burner and the checkerwork hearth. This is a good feature where head room is limited. The round flame burner can also be installed with the air admitted through checkerwork. The usual and more modern adaptation of the round flame burner is to use an air register, as with the mechanical burner.

These burners have a wide operating range and can show high efficiencies at low and medium ratings. The efficiency at high ratings usually drops off more rapidly than is the case with the mechanical burner.

OIL BURNING SYSTEM

An oil burning system is made up of a number of items, and the success of the oil burner system depends on how well these items are correlated.

The system is made up of the oil storage tank, strainers, pumps, heaters, oil burners, combustion chamber, controls, piping, electrical work and various accessories.

There are definite rules and regulations pertaining to the installation of oil burning equipment. In some localities the installation may be governed by city ordinances. In others the state has its rules. Where neither city nor state rules are in effect, it is customary to install the system in accordance with the rules and regulations of the National Board of Fire Underwriters. Rules work no hardship and are of the common sense variety promulgated to safeguard the operation of the system and to eliminate the possibility of any fire hazard.

Careful planning and engineering plus good workmanship, with adequate supervision, are a necessary part of any good oil burning installation.

Fuel Oil Storage Tank

Although the first consideration is the size of the storage tank required its selection is not governed by hard and fast rules. Consideration must be given to the rate at which the fuel will be consumed and the availability to a source of supply. In localities where oil can be delivered by tank truck with only a few miles haul, the tank can be kept filled without any difficulties. Under these favorable conditions it is advisable to figure on a tank holding not less than one week's supply of oil. In the case of plants where the load is primarily a heating one, it is usual to approximate the annual fuel consumption. January, being the coldest month, will take about 20% of the total requirements for the heating season. One-fourth of the January figure will represent one week's supply under the most adverse conditions. For example, a heating plant having an estimated fuel consumption of 50,000 gallons per heating season will burn approximately 10,000 gallons in January. The tank for this plant should have a capacity of not less than 2,500 gallons and a 3,000 gallon tank would probably be the choice.

In the case of a conversion installation in a manufacturing plant, laundry or other type of industry, it is possible to estimate the oil consumption on the basis of previous coal consumption as provided on a month to month basis.

The plant that has its fuel oil delivered by rail must take other factors into account. The storage tank must be capable of taking a full tank car delivery and have a sufficient reserve to allow for delays in shipment. Tank cars range in capacity from 8,000 to 12,000 gallons. It is therefore obvious that the minimum storage capacity should be not less than 15,000 gallons. A better figure is to allow storage capacity for at least one week's consumption plus carload capacity.

Storage tank construction is not a matter of lengthy discussion. The tank must be constructed to conform to any local rules having jurisdiction or where these are lacking, it is customary to install an Underwriters' tank, that is, one which is built to conform to Underwriters' specifications.

Preferred tank location is below ground outside of the building. The Underwriters' specify that the tank should be buried so that the top of the tank is at least 2 feet below grade. In localities where the load bearing qualities of the soil are poor, it is necessary to provide a concrete slab to prevent the tank from settling. In cases where water is encountered it is necessary to provide a concrete slab of sufficient weight to prevent floating and to anchor the tank securely to the slab with hold-down straps.

Tanks can be located inside the building if space limitations prevent its being located outside. The installation procedure, if not covered by local regulations, again is covered by the Underwriters. It is frequently necessary to build the tank on the job when large inside tanks are used. The tank is enclosed in either concrete or brick walls of specified thickness. The space between the enclosure and the tank is filled with sand and if the ceiling over the tank is not fire resistant, a concrete slab is poured over the top of the tank. It is evident that the inside tank is more expensive.

The storage tank for residual fuel oils requires an access manhole so that the tank can be inspected and cleaned. A masonry or concrete enclosure should be provided around the tank manhole with a manhole cover at the grade level.

The fill line will vary in size from 3 to 6 in. for the heavy residual oils. Its size depends on whether oil is pumped into the tank or dumped by gravity. The system must have a vent line terminating in a weatherproof head, a sounding and sludge removing line, and a connection for a tank gauge. Fuel oil suction and return lines should be located and arranged at the tank to provide the shortest and most direct run to the oil pump.

Heating the Oil

Means for heating the oil in the storage tank must be provided when burning heavy No. 5 or No. 6 oil. The most common arrangement is the heating coil. A vertical helical coil is preferred to a horizontal grid on the tank bottom. The vertical coil surrounds the suction stub and heats the oil in the vicinity of the suction pipe sufficiently to insure a proper flow to the oil pump. A suction coil requires the use of steam at sufficient pressure to blow out the condensate, or a vacuum pump if it is available. When neither high pressure steam nor a vacuum pump is available, it is then necessary to circulate hot water through the coil.

An alternate method is to use a suction bell on hot box in the tank. A confining chamber is placed on the bottom of the tank. Suction stub and return line stub are both connected to this chamber. Excess oil returned to the tank is heated by means of a fuel oil heater in the boiler room; the hot oil is returned into the suction bell and raises the temperature of the oil in the bell to a suitable temperature for pumping.

A third heating method for the oil between the tank and fuel pump is by electricity. This method has considerable merit for certain types of plants. It consists of a step-down transformer, and adjustable thermostat, a tank fitting and special insulated pipe connections. Fuel oil suction and return lines form a low voltage electric circuit and the oil is heated electrically to a controlled temperature. A return line fuel oil heater using steam or hot water is included to supplement this system and cut down on the electric cost of operation. This method is no postwar dream but has been used successfully on quite a number of heavy oil installations in the east. The electric system permits using smaller pipe sizes than usual due to the oil being

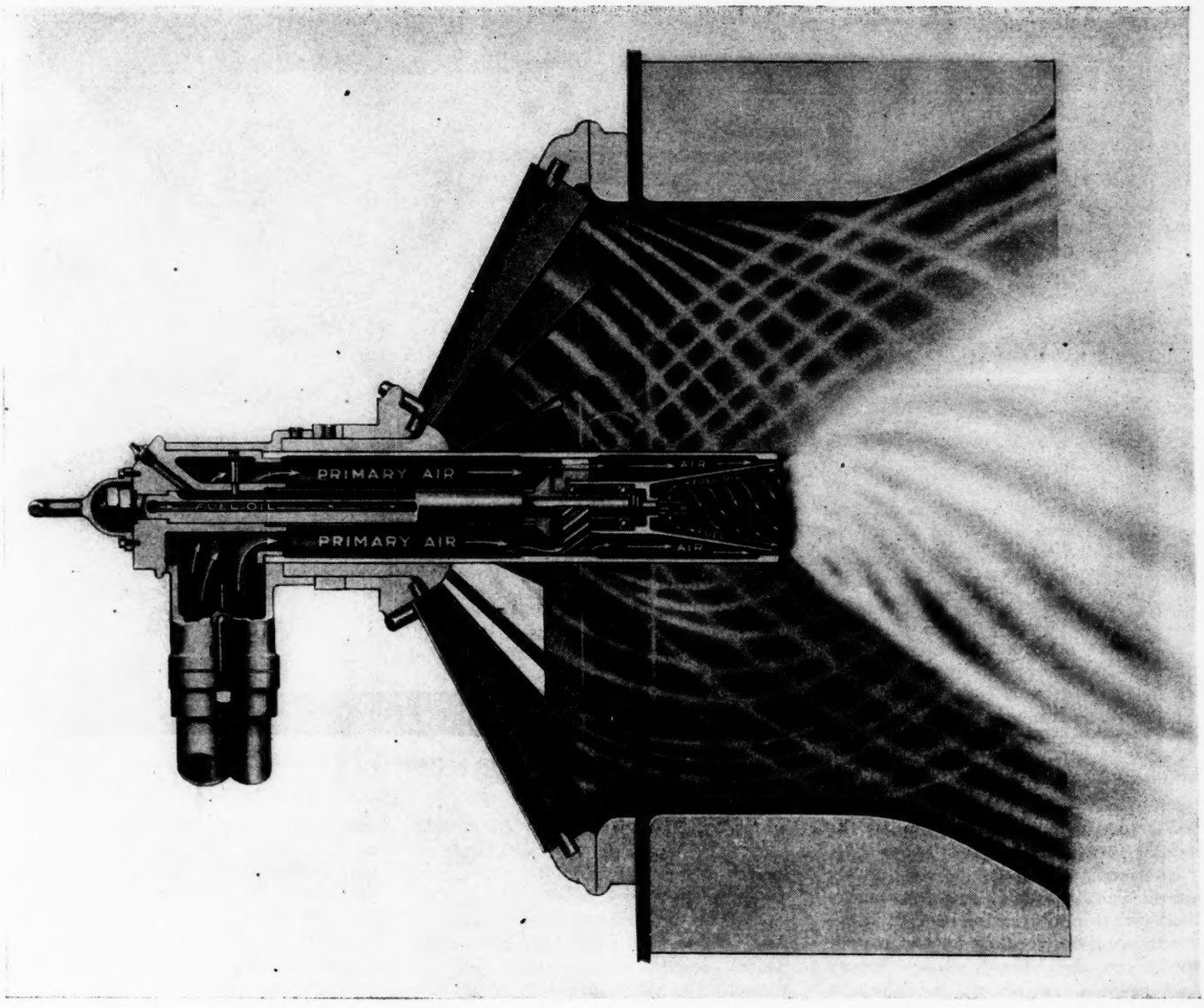


Fig. 6. Sectional view of air turbine driven rotary cup oil burner.

heated uniformly and entirely between the tank and pump.

Fuel Oil Pumps

The fuel oil pump is the heart of the oil burning system and it may be built integral with the burner when the horizontal rotary cup burner is used. This is a decided advantage because it simplifies the installation and eliminates the expense which would result if separate pumps were used. The integral pump is not always used as there may be conditions which prevent its use. This condition occurs when the tank is located at a considerable distance from the boiler. It then becomes necessary to use a separate pump, to locate the pump convenient to the oil tank, and to transfer the oil over to the burner. In this case the burners are furnished without the integral pump.

Integral pumps on the burners or the separate motor driven pumps are the rotary gear type. Fuel oil pumps, particularly those for use with the heavy residual fuel oils, should not be operated at full motor speed. In the case of the integral pump built into the burner, the speed is reduced by a worm and worm gear. The separate pumps may have their speed reduced by either a reduction gear or by pulley and V-belt drive. The speed should preferably be less than 300 rpm for proper pumping of these viscous oils.

Mechanical pressure atomizing and the steam atomizing burners are installed with steam driven fuel oil pumps. These pumps are the reciprocating type and controlled by a pressure operated pump governor. In addition to the steam driven pump, an electric pump is sometimes installed for cold starting purposes when steam is not immedately available. The electric pumps for the mechanical burner must be capable of building up high oil pressures and may be of the rotary gear or rotary screw type.

Regardless of the type of pump used, it should be protected by a suitable strainer on the suction side and a pressure relief valve on the discharge side.

Pumps should be adequately sized and have 1½ to 2 times the actual burner capacity. This is necessary in order to have a good circulation of oil through the return line back to the storage tank. It is of particular importance when the fuel oil is heated in the return line and returned into a suction bell or hot box in the bottom of the storage tank.

A vacuum gauge should always be installed between the strainer and the pump. The cost is little and the information the gauge reveals is great. A vacuum gauge so located will indicate when the strainer needs cleaning, whether or not there is a leak in the suction line and also when the oil is getting low in the tank. It can also be used to test the pump by closing the valve ahead of the strainer and reading the vacuum when pulling against the closed valve. The vacuum gauge is too frequently overlooked and omitted.

Trouble in pumping fuel oil is too frequently blamed on the pump. The pump is seldom at fault. In most cases the trouble is due to an air leak in the suction line. A suction line must be *absolutely* air tight or trouble, and usually plenty of it, will result. Any line under pressure can leak and the only result is a nuisance to clean up. A suction line being under a partial vacuum does not show a leak visually and results will

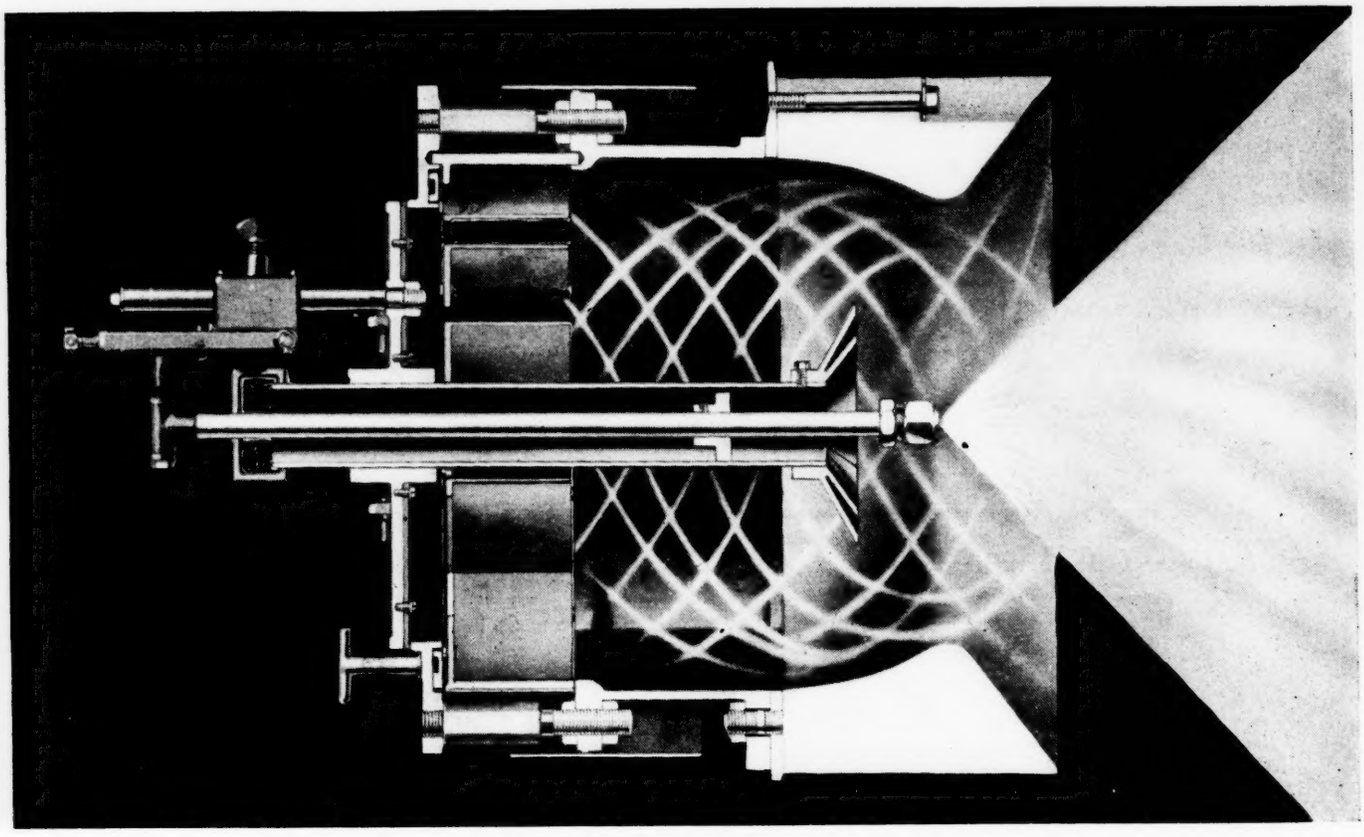


Fig. 7. Sectional view of mechanical pressure atomizing oil burner.

be decidedly unsatisfactory until the leak is located and made tight.

Suction pipes must be adequately sized. The oil burner or pump manufacturer should be consulted if there is any question regarding the proper sizing of the suction line. Every reasonable effort should be taken to locate the oil storage tank so as to provide the minimum possible lift between the bottom of the tank and the pump location. Suction lines should be run as direct as possible and with the least number of elbows and tee fittings.

Fuel Oil Heaters

The purpose of a fuel oil heater is to raise the temperature of the fuel oil and thereby reduce its viscosity to the point where proper atomization results when the heated oil passes through the burner. Preheating the fuel oil is required with all No. 6 oil and with some No. 5 oil, particularly where characteristics of the No. 5 oil approach the maximum limits of the Commercial Standard Specifications.

Steam is the most common medium employed for heating oil. Steam supplied heaters consist of a steel or cast iron shell containing a bundle of tubes. Shell and tube heaters are made up as follows:

a. Straight tube
b. U-bend tube
c. Helical coil tube

These heaters can have the oil passing through the tubes and the steam fed into the shell or may be designed so that the steam is in the tubes and the oil is in the shell. The choice in heater design is not whether steam or oil is in the tubes or vice versa, but should be determined on the basis of cost, space requirements, accessibility for cleaning and adequate capacity without too much pressure drop.

The selection of a fuel heater should be based on the following items:

1. The heater should have ample capacity. Heaters are rated on the basis of clean heating surface and will lose some capacity as the heating surface becomes fouled.
2. Heaters are designed with multiple passes usually ranging from 2 to 6. Naturally, there is some pressure drop as oil travels through the heater. It is therefore important to obtain adequate heating capacity without excessive pressure drop.
3. Heaters must be built and tested to suit the working pressures of both the steam and oil.
4. Heater should be arranged so that it can be cleaned without having to disconnect all piping.

Heaters require a temperature controller to regulate the temperature of oil leaving the heater. A thermostatic bulb immersed in the oil line at the heater outlet which actuates a steam valve is employed for this purpose. A magnetic steam valve is a good feature on automatic burner installations. The magnetic valve in the steam supply line shuts off the steam when the burner is stopped. This prevents the steam from coking the oil on the heater surfaces as would happen with steam in the heater and no oil circulating through the heater. The magnetic valve is wired into the control circuit so that it opens and closes as the burner starts and stops. Heaters should be protected by a small relief valve which will relieve any excessive pressures resulting from expansion of the heated oil. A steam trap is required to handle the condensate.

Low pressure steam heating plants frequently have the fuel oil heaters connected below the water line and use boiler water as the heating medium. This makes a most satisfactory arrangement, particularly with automatic burners. In cases where the boiler is off over night, the water temperature may still be sufficient to preheat the oil on the morning start-up. This cuts down on the use of the electric heater provided for cold starting purposes.

Electric heaters are provided as an auxiliary means of heating fuel oil under cold starting conditions. The electric heater consists of a sheathed resistance element immersed directly in the fuel oil. Electrical capacity depends on the quantity of fuel oil to be heated. Experience shows that an allowance of 1 kw heater capacity is suitable for heating about 12 gallons per hour. In the case of fully automatic rotary cup burners the electric heater is thermostatically controlled. A relay is necessary with the larger sizes of electric heater. The thermostat actuates the relay coil and the heater current is passed

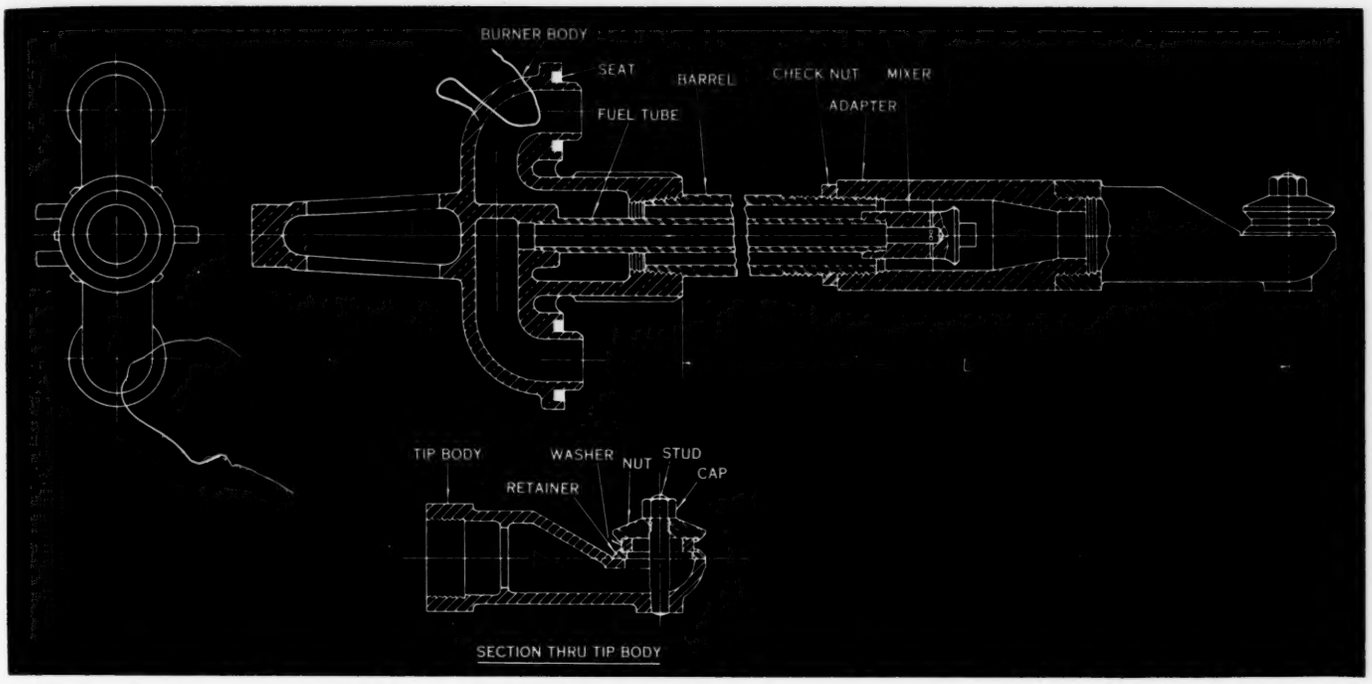


Fig. 8. Steam atomizer with flat flame nozzle.

through the relay contacts. Electric heaters for use with semi-automatic or manually operated burners are provided with 3-heat control snap switches. The 3-heat control provides a convenient means of regulating the temperature of oil leaving the heater. A tell tale light should be provided to indicate that the electric heater is in use. Electric heater elements may be provided with a special heater shell or may be immersed directly in the piping. Provision should be made for removing the electric element for cleaning or replacement without having to disconnect the piping.

Hot oil lines between all heaters, as well as the heater shells, should be insulated with pipe covering.

Thermometers should be provided at convenient locations to indicate the temperature of oil at the pumps, at the heater discharge, and also at the oil burners.

Proper and adequate heating of the fuel oil to closely controlled temperatures is a necessary feature of any oil burning system which is to burn the low cost heavy residual oils.

Combustion Chambers

Oil burner manufacturers spend large sums of money in developing and improving their burners. This engineering and laboratory work is constantly going on for the purpose of providing the best possible oil burner at the lowest possible cost. A good oil burner is a necessary requirement for any oil burning system. A properly designed and constructed combustion chamber is equally important.

The oil burner prepares the fuel for burning. Actual burning takes place in the combustion chamber. The best oil burner made cannot overcome the deficiencies of a poorly designed chamber.

It is particularly true at this point of the installation that there is no substitute for experience.

The combustion chamber is constructed of refractory materials, firebrick or plastic refractories. Refractories used must be capable of withstanding furnace temperatures and other conditions to which they will be subjected.

The two principal considerations to be kept in mind are:

1. Size
2. Shape

The combustion chamber must be adequately sized for several reasons. First among these is that the oil must be burned in suspension. Impingement of unburned oil on the walls or floor must be prohibited, otherwise carbon formation will result. Sufficient volume must be provided to prevent excessive furnace temperatures, otherwise the refractories will not stand up. This leads to the question as to just what is combustion volume. Combustion volume can be figured as the space enclosed by the floor or hearth, the walls and the crown sheet, shell or boiler tubes. However, all of this space may not be effective volume and it is again, at this point, that experience is the best guide.

Definite limitations are imposed by the firebox dimensions of the boiler. One measuring stick used in determining the size of the chamber is the heat release per cubic foot. This is determined by dividing the volume in cubic feet by the total Btu in the quantity of oil to be burned per hour. The usual figure is between 30,000 and 40,000 Btu heat release per cubic foot per hour. This works out on the basis of 5 to 3¾ cu ft of combustion volume per gallon of oil consumed per hour. These figures cannot be used alone, as the width to length ratio and height, all must be in some sort of balance. The furnace temperature will increase as the Btu release per cubic foot increases. Where combustion volume is definitely limited by conditions on the job and where heat releases greater than 40,000 Btu per cu ft will result, it is advisable to go to the use of super-duty refractories. The foregoing applies to the usual type of boilers with brick settings.

In the case of water tube boilers with water cooled furnace walls, the heat release per cubic foot can safely be increased. However, boilers with water cooled furnaces are not usually found below 300 hp rating except in the case of the Scotch Marine type.

The shape of the combustion chamber should be predicated on two primary factors. The first is to obtain the greatest flame distribution without impingement, taking into account the size and shape of the flame. The second is to obtain the greatest amount of flame travel so as to insure the process of combustion being completed before the hot gases enter in the flue passages. Wing walls may be provided at the front of the furnace to eliminate recirculation of burnt gases and to increase the temperature around the atomized oil and speed up the flame propagation.

An ignition arch over the burner opening at the front end of the furnace may be of considerable value, particularly if the burner is to be operated at a low fraction of its capacity.

With the horizontal rotary or steam burners not using registers, secondary air openings are provided in the floor to admit the air required to support

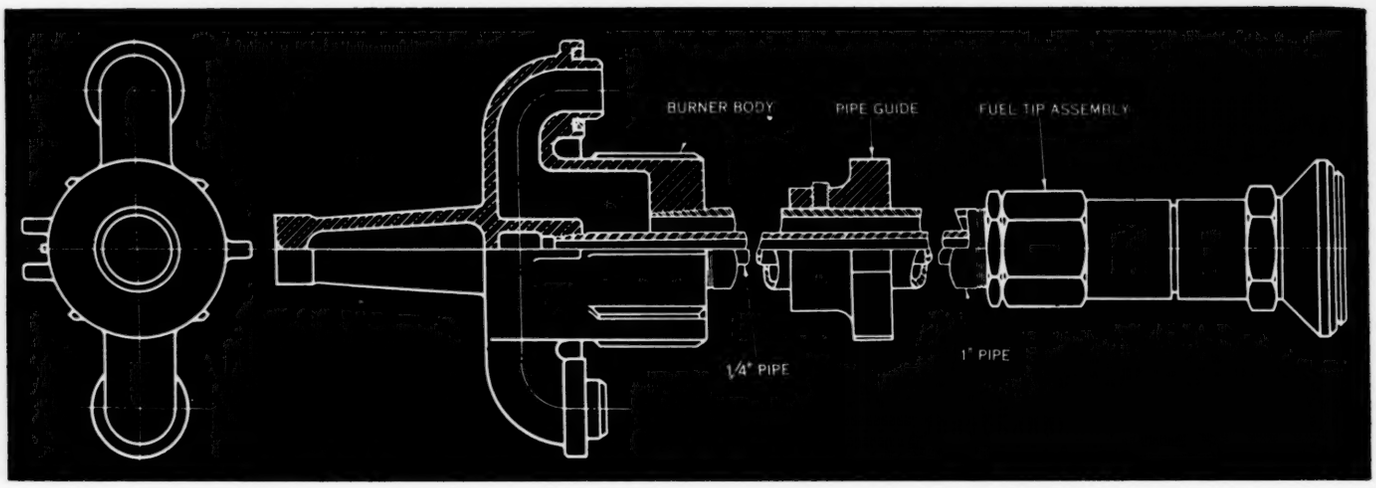


Fig. 9. Steam burner atomizer with round flame nozzle for register applications.

combustion. Openings should be located so that the air will come into intimate contact with the atomized oil and be utilized to the best advantage. The best arrangement is a series of slotted or checkerwork openings which will distribute the air in the furnace. Air admitted is controlled by a damper located below the burner. The free area of the damper can be figured on the basis of 4½ sq in. per gallon of oil. The free area of the slotted or checkerwork openings can be figured by allowing 6 sq in. per gallon of oil burned per hour.

The combustion chamber must necessarily be sized and shaped to suit the maximum load condition. It is frequently too large for light load conditions. Therefore, when operating with a light load, as may occur during the summer, it is sometimes advantageous to lay up a dry bridge wall to shorten up on the length and even put in temporary side walls to reduce the volume and increase the operating temperature.

The firebrick manufacturers' representative can be of assistance in determining the choice of a suitable refractory brick and high temperature cement. It is poor economy to use anything but the proper refractory for the particular conditions to be encountered. A super-duty firebrick may be the best choice where conditions are severe but it is also a waste of money to use a super-duty refractory where conditions are known to be moderate.

Good workmanship is an essential part of furnace construction. A good firebrick mason knows when to install header courses to tie together the stretcher courses and also knows how and when to install an expansion joint.

A good combustion chamber can be described as one showing a uniform incandescent surface throughout when the burners are shut off. There will be no black corners or cool spots. This incandescent surface reflecting heat on the atomized oil from all directions, when the burner is operating, is what causes rapid vaporization of individual particles and insures complete combustion before combustion products enter the boiler flues.

CONTROLS AND ALARMS

Control of oil burners may be classified as

1. Full automatic
2. Semi-automatic
3. Manual

The electric motor driven horizontal rotary cup type of burner is the only one which is commonly offered as full automatic. Full automatic control means that the burner starts, ignites and operates at the closing of a switch. This switch may be in the form of a thermostat, steam pressure actuated switch or pressure control, or by a temperature controller or aquastat operating from the boiler water temperature. The burner is usually supplied with electric-gas ignition. An ignition transformer ignites the gas and the gas pilot flame, in turn, ignites the oil. The ignition is automatically shut off after oil ignition has taken place and combustion established.

There are several types of combustion safeguards which will shut off the burner in the event of the flame becoming prematurely extinguished.

The simplest of all the controls to shut off the oil burner in the event of flame failure is the stackswitch. It consists of a helical bimetallic element which is inserted in the smoke pipe or breeching. The hot flue gas causes the helix to rotate a small shaft which closes and maintains a switch circuit. Any appreciable drop in flue gas temperature causes the helix to open the switch thereby shutting off the oil burner. The stackswitch is well suited for application to small boilers but is slow acting with large boilers. The speed at which a stackswitch reacts depends on length of flue travel in the boiler, and velocity of the gases.

Protectostat. This is a fast acting flame failure control. It consists of a cast iron housing containing a sprung diaphragm black coated for best heat absorption. The protectostat is located on the boiler front so that it "looks" at the fire. The diaphragm expands promptly to close its switch contacts on ignition of the fuel oil and contacts very rapidly to break the circuit when the flame is extinguished. It is very well suited for fixed size flame with intermittent operation.

Visaflame. It is another flame failure control consisting of a small spherical glass bulb, one-half of which is silvered and forms a reflecting mirror. The bulb is mounted in a sighting tube which is mounted on the boiler front so that the transparent half of the bulb is toward the oil flame. Light rays from the flame are reflected by the silvered half of the bulb and are focused on a spiral thermostatic coil. Focused light rays create sufficient heat to cause the coil to expand and dip an electrode in a pool of mercury. An iris shutter is provided in the sighting tube to control the amount of light admitted. This control has a low electrical current carrying capacity and it is necessary to use a special low voltage relay in conjunction with it. This control is well suited for use with modulating fires.

Photo-electric Eyes. There are also several photo-electric eyes available. These controls act instantaneously to make a circuit on oil ignition or break a circuit on flame failure. The electric eye is sighted at the flame and provides the fastest of all response to flame failure.

Any one of these controls when used with a fully automatic burner, is tied into a master control panel or sequence controller. These control panels or sequence controllers are energized by a steam pressure actuated switch, a thermostat, or both. The panel or controller closes the

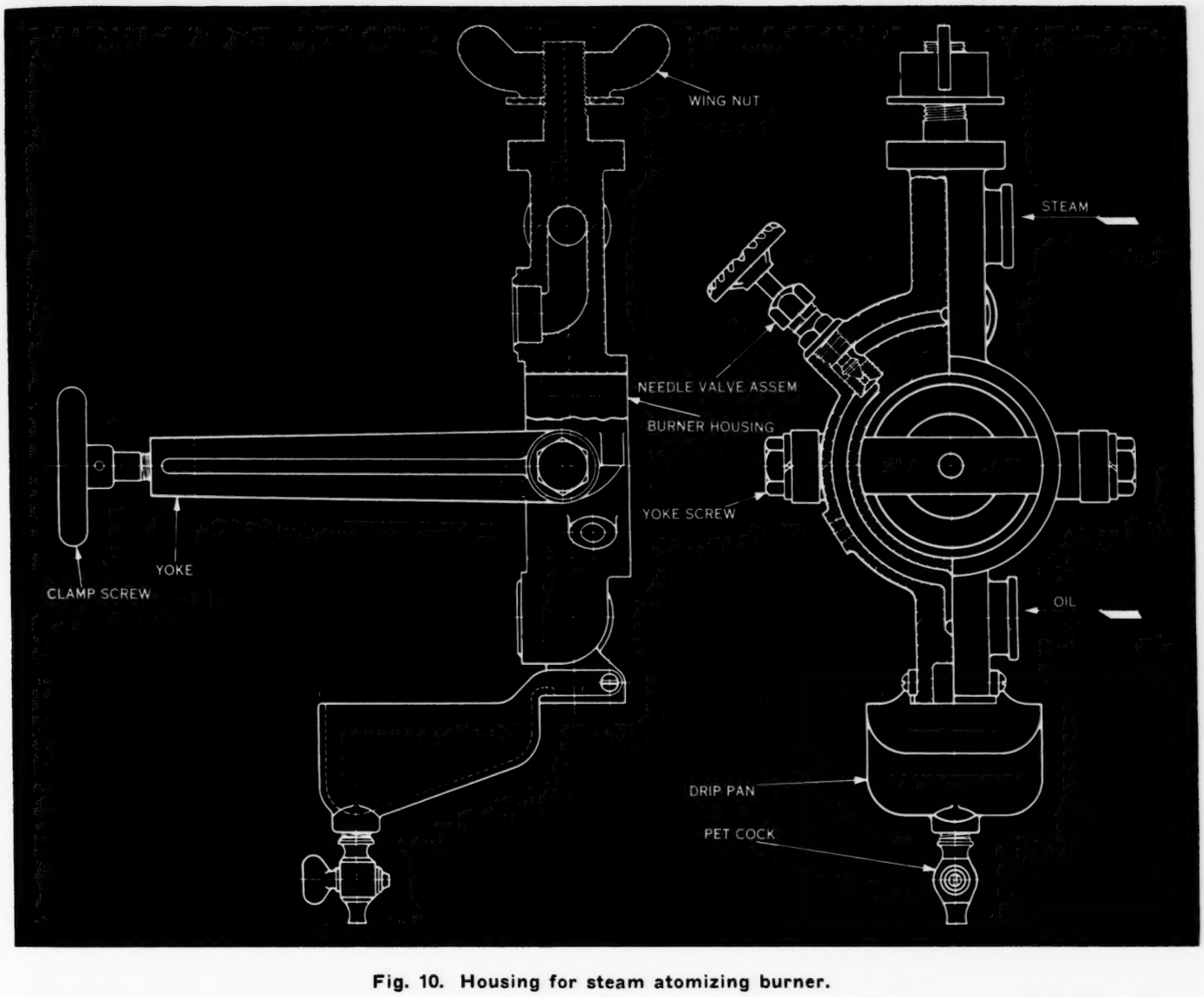


Fig. 10. Housing for steam atomizing burner.

circuit to the electric-gas igniter or pilot burner and the oil burner motor. The magnetic oil valve is then energized allowing fuel to pass through the burner and ignition takes place. The combustion control then establishes a maintaining circuit if normal oil ignition takes place; otherwise, the burner is automatically shut off within a matter of seconds. The electric-gas igniter is automatically shut off after oil flame is established.

There is also an additional safety control available with the photo-electric flame-eye. This is an electrode located in the path of the electric-gas igniter. The electrode detects the presence of the gas pilot flame. The gas flame itself is used to conduct a very low voltage current. In the event of electric-gas pilot failure, no circuit is established through the igniter and the magnetic oil valve on the burner cannot open.

Fully automatic horizontal rotary cup burners are usually equipped with a modulating damper control motor. The modulating motor is controlled by a potentiometer type steam pressure actuated controller. The damper motor is link connected to the primary air control shutter, the secondary air damper under the burner and the oil flow control valve. Fire is then modulated in step with steam demand and maintains a constant steam pressure. The burner firing rate is kept in step with the load and provides continuous firing.

A relay can be included which will cause the burner to start on a low fire and gradually increase to full fire after ignition has taken place. This makes the ideal arrangement as the oil burner is not over-firing or under-firing. The burner will shut off automatically only when the load demand falls below the minimum firing rate of the oil burner.

Fully automatic burners, when firing a low pressure heating boiler, can best be controlled by a "weather control." This control has a time clock switch plus a temperature bulb located outside the building. The temperature bulb and time clock switch are coordinated to regulate the firing periods as to frequency and length to suit outside temperature conditions. The time switch portion of this control automatically provides night time shut down and can be adjusted for any predetermined time period. These controls are fuel savers.

The ordinary room thermostat, while satisfactory for residential oil burner control, seldom is satisfactory for multiple family dwellings or large buildings. It is practically impossible to locate it where it will provide a temperature that will be satisfactory to all tenants. In such cases, the "weather control," described, provides the best arrangement.

Semi-Automatic Control

Semi-automatic control can be applied to the horizontal rotary cup type burner, the steam atomizing or the mechanical pressure atomizing burners. Semi-automatic burners are ignited manually but after the burners are operating, the size of the flame is regulated to follow the steam demand and to maintain a constant steam pressure. Control may be of the electric operated, the hydraulic or pneumatic combustion control type. Electric motor driven horizontal rotary burners can be equipped with a steam pressure limit switch, a low water cutoff, and flame failure controls. The burner then has all of the operating features of the fully automatic type with the single exception that it will not start automatically.

Oil burners having oil supplied

with separate pumps should have an interlocking valve which will prevent the possibility of passing fuel oil through the burner unless the burner is in operation.

Manual Control

Manual control for oil burners simply means that the burners are operated by a fireman. Burners must be ignited by means of a suitable torch and any changes in firing rate require the services of the fireman to regulate the oil flow control valve and position of the air damper or register. This type of control is seldom applied to boiler work. Manually controlled burners are used for firing incinerators and in industrial processes.

Draft Control

Draft control is an important feature on any oil burner installation. The purpose of a draft controller is to reduce, regulate or maintain the draft at the point where the most economical operation will be obtained. The draft controller holds the draft down to a point where the draft is no more, or but little more, than that required for good and proper burner operation. In this way the draft controller makes it easier to govern and control the air flow so as to maintain a reasonably high percentage of CO_2 in the flue gas and also slows down the velocity of the gases passing through the boiler. The reduction in velocity is important in that the hot gases can give up the largest possible amount of heat to the boiler before passing into the smoke pipe or breeching.

The simplest type of draft controller is the barometric type. It is usually located on the smoke pipe or breeching but can be located at the base of the stack or chimney. It consists of a balanced swinging damper which is extremely sensitive to changes in the draft intensity. The swinging damper is adjusted by weight loading to maintain whatever draft is desired in the combustion chamber. It is entirely automatic and does not restrict the smoke pipe in any way. The barometric draft controller is mounted on the side of the smoke pipe or breeching and as the draft changes due to wind velocity or weather conditions, the controller admits more or less air from the boiler room into the smoke pipe and the draft in the combustion chamber can be held within very close limits. It can be considered as an automatic check damper. The area of the opening in the barometric damper should be at least equal to the cross-sectional area of the smoke flue and on large jobs with high stacks the area of the damper should be even greater. The barometric type is well suited for the small and medium size boilers up to around 150 horsepower nominal rating.

The other type of draft control is by positioning the outlet damper. This is more expensive and not as simple as the barometric type. It is preferred for large boiler installations of 150 hp or more. The control consists of a furnace draft regulator which is sensitive to the slightest variation in furnace draft. The regulator is tied into a positioning motor which may be of the electric, hydraulic or pneumatic type. The positioning motor shifts the position of the boiler outlet damper to control and regulate the flow of gases from the boiler.

One type in particular is well suited for automatic burner operation. It closes the boiler outlet damper when the burner stops automatically. When the steam pressure switch signals to start the burner, the pressure switch first causes the boiler damper to be swung into the wide-open position. A switch arrangement on the damper prevents the burner from starting unless the damper is wide open. Once the damper is in the wide-open position, ignition of the oil burner can then take place. Hot gases leaving the boiler, after ignition takes place, actuate a stackswitch which closes the circuit to the overfire draft controller and the draft controller can then position the outlet damper to reduce and maintain the furnace draft as suited to the operation of the oil burner. This type has an electrically operated positioning motor which is very responsive to the draft regulator.

Smoke Alarms

Smoke alarms are available which are helpful in localities where smoke ordinances are enforced. The smoke alarm consists of a photo-electric cell which is mounted on one side of the smoke breeching and sights through the breeching to an electric light bulb mounted on the opposite side. Any smoke passing through the breeching will decrease the amount of light intensity acting on the photo cell. This in turn causes the photo cell to change the electric current flow between it and its signal box. The signal box then flashes a warning light or sounds an alarm or both. One control of this type flashes a green light when the breeching is clear and a red light when smoke is present. A slight haze in the stack which is indicative of good CO_2 and low excess air results in no light showing on the alarm. These controls are a help to the fireman, particularly where the top of the stack is not visible from the boiler room.

Ventilation

Adequate boiler room ventilation is frequently overlooked. This is more apt to be true with low pressure heating plants where the boilers are located in the basement than in high pressure power plants. This is also true with any fuel as well as oil. The quantity of air required to adequately support combustion is a sizable item and provision should be made for free access of fresh air into the boiler room. A guide in this matter is to figure on an opening with a free area at least equal to the cross-sectional area of the smoke breeching.

FUTURE POSSIBILITIES

The war forced the majority of owners of heavy oil burning equipment to convert from oil to coal. Most of these burners will be reinstalled. Some have already been reinstalled. The post-war equipment in these plants will be prewar equipment. A few of the plants, where oil burning equipment is old and worn. will probably be considering more modern burners.

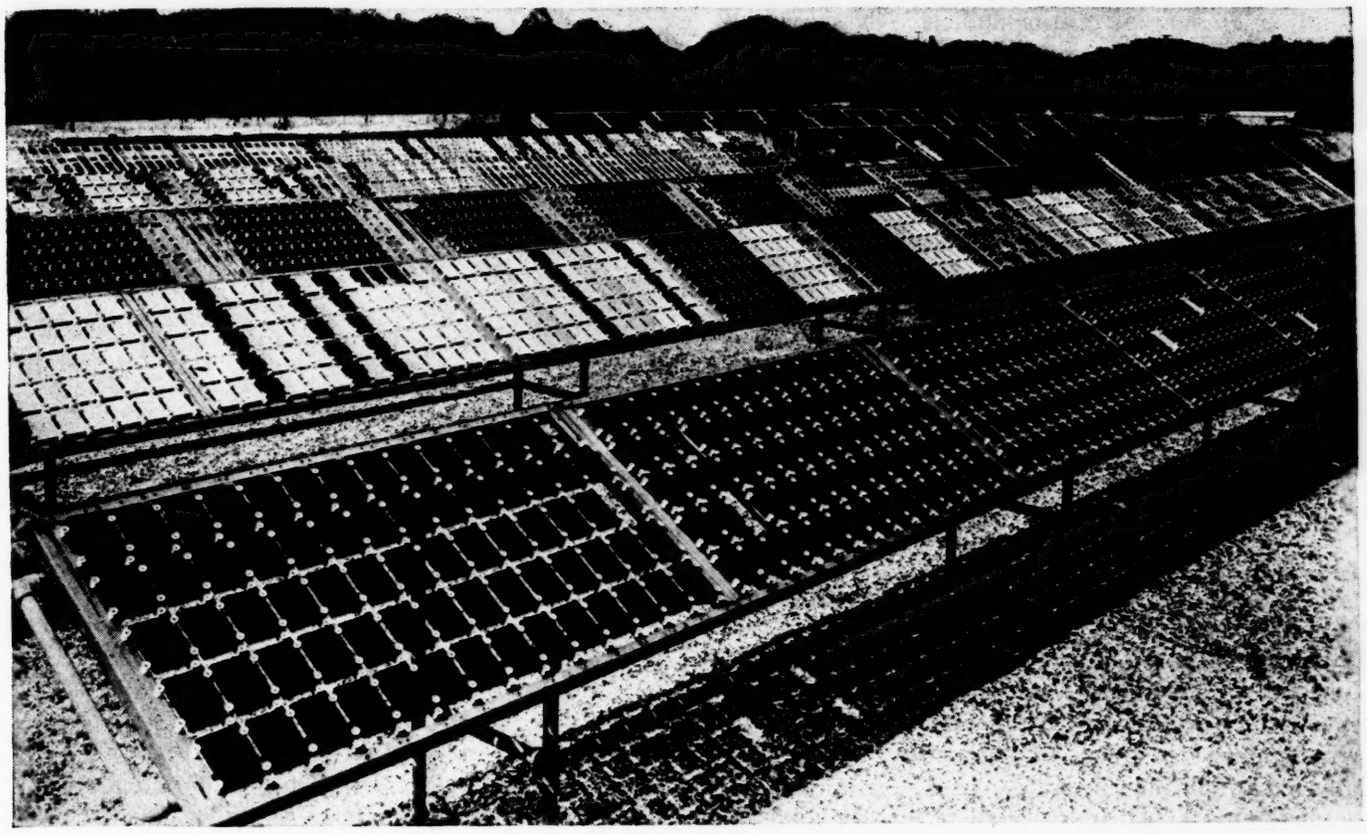
Post-war oil burners will not be radically different than prewar oil burners. There will be improvements. There would have been improvements regardless of the war. Most burner manufacturers are constantly improving their products, based on findings in the laboratory and experience in the field. These improvements are for the most part refinements in design.

Manufacturers will be quick to seize on the use of new metal alloys which will provide lighter weight without sacrificing strength and alloys which will benefit the burner parts subjected to the heat of the furnace.

Electronic controls will become commonplace, but don't overlook the fact that excellent electronic controls were being installed on industrial burners before the war.

Automatic boiler-burner units or automatic oil fired steam generators for both low pressure heating and high pressure process steam will be favored by many users. These units were also available before the war. Some makes of these units will be developed from units which were manufactured originally for military purposes.

The oil burner industry has enjoyed a steady growth since the turn of the century. Much knowledge has been gained. Competition is keen in the industry and as a result better and improved equipment is being provided at a lower cost. Installation men are better trained than was the case in the early years of the industry. Manufacturers usually cooperate closely with the trade and better equipment and installation methods can be expected in the years of peace to come.



General view of the racks on which are mounted the atmospheric test specimens.

How Metals Behave in Sea Air

MORE than 15,000 specimens of various metals and alloys are being exposed to the salt water atmosphere at Kure Beach near Wilmington, N. C., to determine the ability of the metals and coatings to resist sea air corrosion. The study has been under way for the past ten years although most of the samples now exposed have an average weathering period of from four to five years.

The International Nickel Co., the Carnegie-Illinois Steel Co., the Magnesium Division of the Dow Chemical Co., and the Ethyl-Dow Chemical Co. are cooperating in this study.

Actually the marine corrosion testing station is concerned with many phases—how metals will stand up under salt water exposure, how rapidly the metals will foul, the ability of paints and compounds to serve as anti-fouling media. However, since exposure of metals and protective compounds under salt water are not a prime interest to most HEATING AND VENTILATING readers, emphasis will be placed on the results obtained at the atmospheric test lot which is an acre in area. Each rack supports from 700 to 900 specimens distributed on 10 frames and mounted on porcelain knobs used for electrical insulation to prevent electrolytic action and to enable easy removal of the pieces from the rack.

The expense of preparing these specimens for test and also caring for them makes the investment in specimens in this test lot about $150,000. The tests are conducted without prejudice and favor to any metal or coating group. They are designed to supply the answer to the question of which specimens will show the greatest resistance to salt air corrosion.

Two groups of tests are conducted. Most of the specimens are mounted on racks 800 feet back from the ocean, but where it is desired to see how the specimens stand up under more severe conditions, they are exposed on an elevated rack, 80 feet back from the mean tide line. Unlike the samples on the 800 ft racks which are mounted at an angle 80 degrees from the horizontal, these are placed at an angle of 45 degrees. A continuous mist of salt spray surrounds the "80 ft samples" and often they are splashed by spray kicked up by the breakers.

Many Tests Being Made

Every conceivable weathering test is under way—straight samples, metals joined with other metals to form a galvanic couple, samples with rivets, bolted samples, strips of metals bent into the testing rack to see how the metals behave when stressed, chemical treatment, paint protection, or a baked enamel coating. Specimens are mounted on four sides of a test house to show the effect of sun exposure time.

Each time a group of specimens is set out, specimens of pure zinc are included as a means of keeping track of any changes in the corrosive characteristics of the atmosphere.

In the ferrous sheet group, zinc galvanized steel with a zinc coating at least 0.75 oz per sq ft has stood up well for the test period of 4.5 years. This means

that that amount of coating indicated is spread to cover both sides of the sheet. Results were also good with sheets protected by coatings up to 2.5 oz per sq ft. Over a longer period of time, it is certain that the heavier coatings will give better results. Even at a scratch mark, the zinc coating will provide protection.

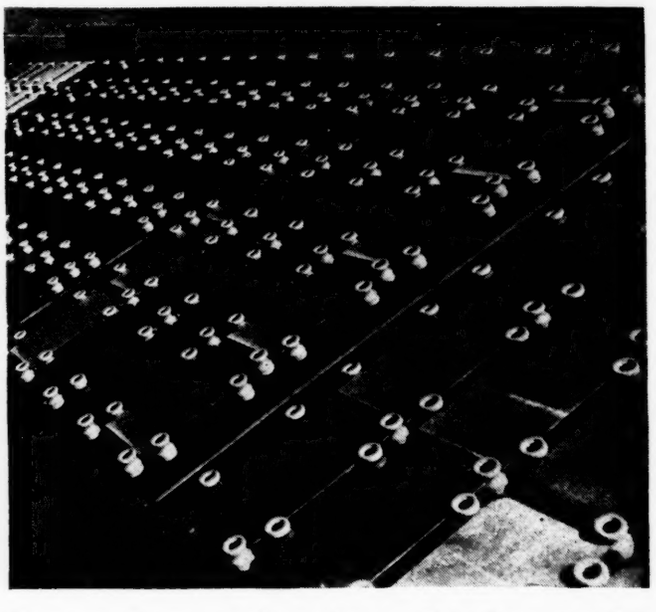
Zinc galvanized sheets were also exposed immersed in sea water and showed that under such conditions a coating of 1 oz per sq ft will last about one year.

Tests of heavily coated specimens in comparison with solid zinc showed that the galvanizing resisted attack as well as the solid metal.

Where two pieces of uncoated steel form a lap, the surfaces that are part of the lap should be painted for added life. Pieces in the shade, where dew persists for a longer time than on specimens in the open, show greater corrosion.

Steels and irons containing less than about 0.04% copper suffered considerable attack, while steels containing small amounts of nickel and chromium alone, or with copper, were much better than ordinary steel or the common copper bearing steels. While stainless steel will stain superficially, it is not damaged significantly by corrosion. The molybdenum containing type 311 stainless steel was the best of these alloys in retaining its original lustre. Spray coatings of lead, aluminum or zinc provide good protection for steel. Wrought iron behaved very much like steel or iron of the same copper content. The poorer the quality of the steel, the more sensitive it is to environment in resisting corrosion; and likewise the superior corrosion resistance of the alloy steels becomes even more evident as the severity of the corrosive environment increases. Also results show that the finer the rust and the darker its color, the better is the steel in resisting atmospheric corrosion.

Monel acquired a uniform olive tarnish but otherwise appeared to be unaffected after exposure to this atmosphere for four years. Nickel was very similar to Monel, while Inconel retained practically all of its original lustre. Copper acquired a relatively heavy, dark film but appeared to have suffered no serious structural damage.



Close-up of some test specimens. Note how porcelain electrical insulating knobs are used for mounting the test pieces.

Of all the screen material tested, type 316 stainless steel was the best.

Seam welds made on J-1 Dowmetal (magnesium alloy) showed transverse cracks at the welds after one year exposure due to locked up welding stresses. However, the cracks can be avoided by proper stress relieving methods. These cracks are more severe with tack welds and they develop after a few months. With Dowmetal J-1h, subjecting the metal for one hour to 400F after welding will relieve the locked up stresses and completely prevent cracking.

Tests are under way to determine how plain or protected bolts stand up with various metals, the results of coupling dissimilar metals, and what type rivets give the best service with magnesium.

The sea-air corrosion tests are still going on, new test pieces are being added, some in the specimen state and some as manufactured items such as aeroplane wings or finished castings. Here at Kure Beach are the basic facts of how metals and alloys behave when subjected to salt air.

Determining If Belt Is Static Conductive

An easy method to determine whether any rubber V-belt, flat belt, hose or other product is static conductive has been developed by technicians of The B. F. Goodrich Company.

Static conductive rubber belts have proved especially valuable in many phases of war work, particularly in operations where a static spark might set off a fire or explosion. They also will have many other peacetime uses, including belts for washing machines and other household appliances.

A simple assembly, using a five or six foot length of lamp cord with standard rubber socket plug, a two-watt Neon bulb, two ordinary clamps or metal prongs and two insulated handles can be readily constructed for the tests. One of the wires of the cord is cut, the Neon bulb inserted in a standard base, the insulated handles installed near the end of each wire and the prongs attached to the wires.

To make the test, part of the belt or other rubber product is moistened with water, leaving a dry section eight to twelve inches long between the moistened surfaces, the testing assembly is plugged into any 110 volt alternating current line, and the clamps or prongs applied to the moistened surfaces, with the dry in the middle. If the bulb glows, the rubber product is a static conductor.

The belt or other article under test must be suspended in the air between the clamping points, or rest on a table or other surface which has been insulated so it is non-conducting.

Atmospheric Pollution Due to Dust and Cinders

ARTHUR C. STERN

Enough minute particles of matter are discharged from chimneys and stacks to so pollute the atmosphere of large population centers, as to make air pollution a major problem. Methods of making dust counts and the significance of such data are discussed. Abatement measures are also considered.

NATURAL processes of disintegration and attrition such as wind and stream erosion, wave action, diurnal expansion and contraction due to warm days and cool nights, and biological decay, have for generations created countless minute particles out of originally massive mineral, plant and animal substance.

At this very moment, winds sweeping close to the ground are picking up some of these particles; evaporating sea spray droplets to leave behind airborne salt particles; volcanic ash particles are being explosively erupted into the air. These actions, occurring as they may far from inhabited areas, serve to keep our atmosphere continuously charged with a basic dust loading that cannot, by any reasonable yardstick, be considered as atmospheric pollution.

Without this basic dust content, many characteristics of an unpolluted atmosphere could not occur. Both fog and various forms of precipitation would most likely not occur as we now know them if it were not for the basic dust content of the atmosphere.

Habitation Increases Dust

Mere habitation of an area, even if only for agricultural pursuits, introduces factors which add to the dust content of the surrounding atmosphere. Soil tillage was as responsible for our midwestern "dust bowls" and dust storms as the winds which transported the dust. Forest fires, which charge air with smoke and tree fragments are man-made, too, as are dusty roads. Abatement of these rural dust sources are, however, usually tackled as problems of conservation rather than as nuisance problems. Although dust or smoke from a rural dust storm or forest fire may occasionally pervade an urban atmosphere, it is rarely that winds approaching a city from a purely rural quadrant will contain significantly more dust than the basic dust loading of winds from uninhabited areas. Dust in our urban atmosphere is therefore predominantly of local origin.

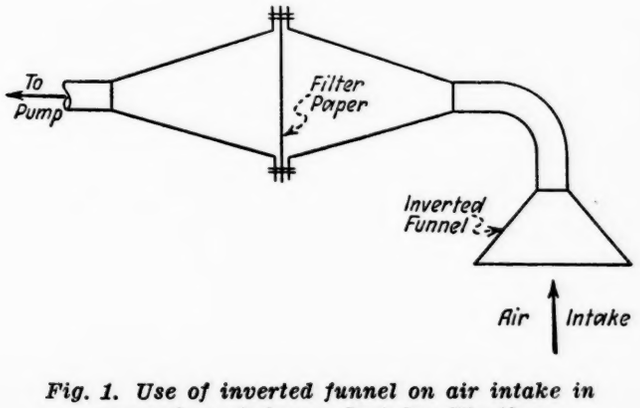


Fig. 1. Use of inverted funnel on air intake in measuring air-borne dust by filtration.

Dust in City Air

Some city dusts are more or less accepted as the normal result of community living and are scarcely termed pollution. Thus lint from clothing, furniture and rugs forms so much of our house dust; abraded particles from sidewalks, streets, rubber tires and shoe leather form much of our street dust; and the dusts incident to the construction, demolition and repair of buildings and structures are all accepted as part of city dwelling. In general we reserve the term pollution to describe dusts emitted from chimneys and stacks, although we do occasionally find an objectionable dust being emitted from a factory window. That this is a reasonable approach to the problem is evidenced by the fact that the major part of the dust in the air of cities is that from stacks and chimneys.

Methods of Measuring Atmospheric Dust

There are three general methods used to measure atmospheric dust. The first is to aspirate a large air sample through a dust separating device. The amount of air aspirated must be measured and the quantity of dust separated from this air weighed. A second method is to collect a small "grab" sample of a known volume of air and determine the number of particles of dust in it. A third method is to measure the weight of dust settling out of the air into an open topped receptacle of known open area during a specified time interval, usually a month. British practice in the measurement of suspended atmospheric pollution is to measure filter paper blackness by means of an aspirated air sample and translate blackness to an equivalent gravimetric dust loading by means of a conversion factor. However, it has been demonstrated that this conversion factor is far

from a constant, varying greatly with changes in the ratio of sooty to non-sooty dust in the air.

Measurement of Suspended Dust

The quantity of air that must be aspirated to measure the weight of dust suspended in the air depends on the method of dust separation employed. All filters are hygroscopic and difficult to weigh accurately without first drying at an elevated temperature, which unfortunately cannot be done after sampling because of the danger of volatilizing some dust collected on the filter. To avoid this we must collect dust samples having a weight that is so high compared to that of the moisture in the filter that the error caused by not completely drying the filter becomes negligible. To collect a dust sample of relatively high weight necessitates sampling a large volume of air. However, as the quantity of dust collected on a filter increases, so does the resistance of the filter to air flow. Therefore, we must start with a fairly low sampling rate in order that the final pressure drop across the filter be within reasonable limits. In general, with paper filters, we use sampling rates of from 1 to 2 cu fpm for from 12 to 24 hours.

Wet devices such as impingers have not customarily been used for this type test because they require replenishment of evaporated liquid while sampling. Means for automatically maintaining liquid level can easily be provided. If this is done and the water is prevented from freezing in cold weather, the ability of a wet device to operate for many hours at a constant flow rate, i.e. without the build up of resistance such as occurs in a filter, is a distinct advantage, as is the fact that the entire sample may be reclaimed for chemical analysis. Electrical precipitators also possess advantages of constant flow rate and reclamation of the entire sample collected.

In both impingers and precipitators, the sample may be collected and weighed in glass so that a dust sample of smaller weight may be accurately weighed. This means that smaller air samples are required, and, since we may employ flow rates at least as high as those used in filters, sampling time may be appreciably shorter when these devices are used.

It is desirable that a sample of suspended impurity measure only the finer particulate matter which will remain in suspension for a reasonably long period of time without including the larger particles which rapidly settle out of the air. Because of their weight, a few large particles collected in a sample will unduly influence the result. These large particles we measure by "soot-fall" determinations. The significance of the suspended dust test as a measure of the load on air filters in a ventilating system is lost if it actually measures dust which will not normally be drawn into a ventilation air intake. Therefore, to avoid the inclusion of large cinder particles in the weight sample, the air sample should be drawn from an inverted funnel or a baffled box (Fig. 1) so that only particles fine enough to remain suspended through one or more 180 degree reversals of air flow can actually enter the collection device and be measured.

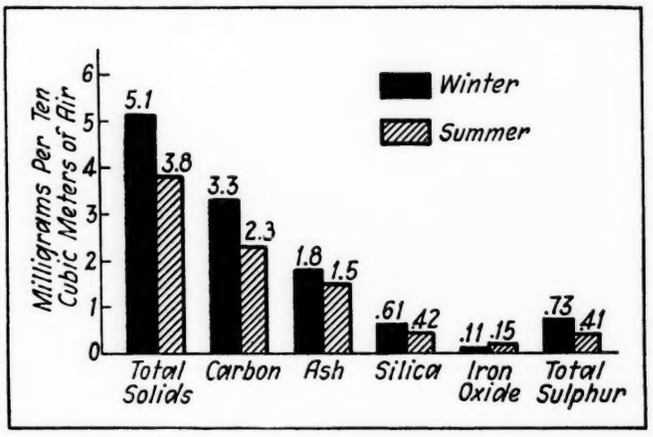


Fig. 2. Average weight in milligrams per ten cubic meters of air, of the various constitutents of pollution in American cities in winter and summer for 1931-1933.

TABLE 1.—BRITISH CLASSIFICATION OF INTENSITY OF ATMOSPHERIC POLLUTION OF CITIES ON THE BASIS OF MEAN MONTHLY SOOT-FALL ANALYSIS—CITIES CLASSIFIED AS A, B, C OR D. (British Class Limits in Metric Tons per 100 sq km are in round whole numbers.)

	Upper Limit of Classification American Tons per sq mile per month		
Designation of Class*	A	B	C
Insoluble Matter			
Tar (CS_2 Soluble Matter)	0.143	0.43	0.71
Carbonaceous other than Tar	2.86	8.56	14.3
Ash	5.71	17.2	28.6
Soluble Matter (in Water)			
Loss on Ignition	2.14	6.42	10.7
Ash	4.30	11.40	21.4
Total Solids	14.3	43.0	71.5
Sulphates	2.86	8.56	14.3
Chlorine	0.86	2.57	4.3
Ammonia	0.143	0.43	0.71

*Deposits in excess of Class C are placed in Class D.

Atmospheric Dust Loading

Sixty-four samples taken in New York City by filtration through filter paper showed[1] an average suspended impurity of 0.37 mg per cu meter, a maximum of 1.40 mg per cu meter, and a mimimum of 0. Three years later 57 samples taken in the same city by collection in a Greenburg-Smith impinger showed[2] a composite insoluble solid suspended impurity of 0.17 mg per cu meter. Ives[3] obtained over 100 7-hour impinger samples in his study of atmospheric pollution in 14 American cities in 1933.

[1]W. P. Yant, et al., Carbon Monoxide and Particulate Matter in Air of Holland Tunnel and Metropolitan New York, U. S. Bureau of Mines R. I. 3585, Nov. 1941, 69 pp.

[2]Feiner, B., and Siegel, J., Air Pollution Survey of New York City Suspended Particulate Matter (Paper to be presented at the June 1945 meeting ASHVE).

[3]Ives, J. E., et al., Atmospheric Pollution of American Cities for the years 1931 to 1933 with Special Reference to the Solid Constituents of the Pollution, U. S. Public Health Service, Public Health Bulletin No. 224, March 1936, 75 pp.

Overall suspended impurity in these cities averages 0.45 mg per cu meter (of which 63% is lost on ignition and therefore assumed to be carbonaceous). The range of measurements was from 0.1 to 1.50 mg per cu meter with 85% of the samples lying between 0.2 and 0.9. Fig. 2 shows the difference between winter and summer pollution and the composition of each as measured in the above study.

Because of variability of results at the same location on different days, very little reliance can be placed on an individual sample of suspended impurity. It is only when enough days have been sampled to average out weather and season variables that the data can be used for comparison and analysis. However, if the sampling locations are not in the immediate influence of individual local pollution sources, very few locations are needed to get accurate information on a city. Such data tell the level of suspended impurity in a city as a whole but do not identify individual or group pollution sources. The prospect of identifying individual or group sources by merely using a large number of sampling locations is not very good because, due to wind and weather, each location averages out the suspended pollution of a large area rather than just measuring that produced locally.

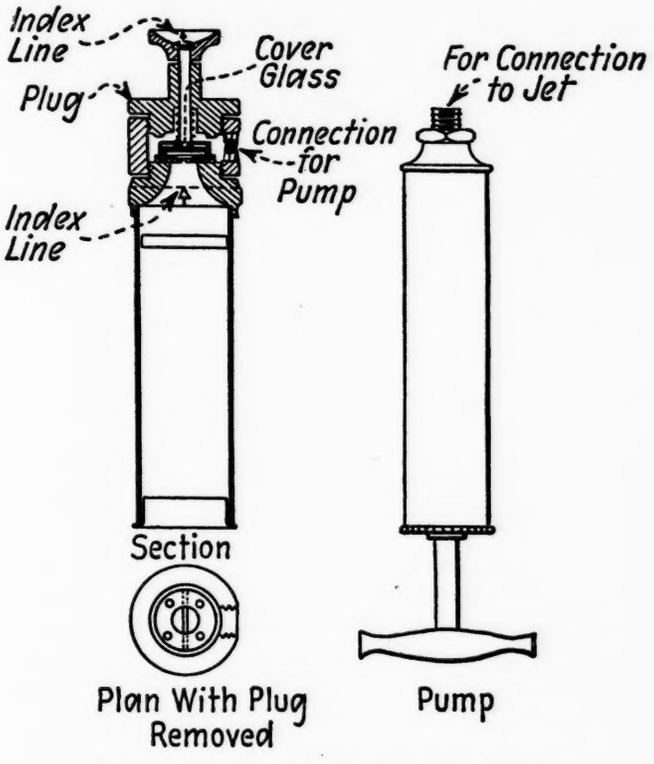


Fig. 3. Details of Owens jet dust counter.

Atmospheric Dust Counts

The Owens jet dust counter (Fig. 3) is the standard instrument for this purpose. In it the air, the particle content of which is to be measured, is first saturated with water vapor from wet blotting paper in the air inlet tube, and is then caused to expand through a slit in front of a glass slide. Expansion causes condensation on the nuclei present and a projection of these droplets onto a slide. Droplet evaporation leaves the particles firmly adhered to the slide by electrostatic and surface forces. Counts made with an Owens jet counter anywhere in the world should be comparable provided identical microscopic methods of examination are employed.

Using standard Owens jet counter technique of oil immersion—dark field-1000X optical system, the average of counts in a number of American cities[3] was 815 particles per cu cm of air, and the approximate range was from 100 to 3000. The average of counts made daily in Washington[4] from 1923 to 1931 was 772 and the range substantially the same. In New York City[2] 450 samples taken by impinger using a light-field low power (100X) optical system yielded counts ranging from 10 to 125 particles per cu cm of air with an average of 32. Counts such as these are of considerable scientific interest, particularly as they relate to rain, fog, and visibility. However, they are of little or no value as a tool in air pollution abatement work.

Soot-Fall Measurement

Matter settling into receptacles is known as "soot fall" and is usually reported in tons per square mile per month. This requires an accurate measurement of the exposed open area of the receptacle employed. This area may either be the top of a cylindrical can or a wide-mouthed glass jar exposed directly; or the top of an exposed glass or metal funnel, the bottom of which enters a narrow-mouthed glass jar. If a can or jar is used without auxiliary funnel, it must be deep enough so that wind eddies will not lift dust out once it has been deposited there. This usually means a can at least 1½ times as deep as its top opening. When a funnel is used, wind cannot pick up material in the jar to which the funnel connects, but it can sweep any material from the funnel walls before it has a chance to enter the jar below. For this reason funnels of steep angle must be employed.

When soot-fall jars without funnels are set out, they are filled to about ¼ of their depth; in summer time with distilled water; in winter time with antifreeze. Water level in the jars increases after each rainfall, decreases due to evaporation between rainfalls. The initial liquid filling should be sufficient to leave the bottom of the receptacle wet at the end of its month's exposure, even if there is no rainfall during the month. Liquid is kept in the bottom as a means, additional to depth, to prevent collected material from being blown out of the jar by wind action. It should be noted that liquid in the jar decreases the effectual depth of the jar and may result in an air column so shallow that particle deposition in the presence of a cross-wind may be incomplete. This consideration therefore sets an upper limit to the quantity of liquid initially placed in the jar. When a large number of jars were used in a soot-fall survey in New York City, it was found advisable to check on the water level in jars mid-monthly during dry months, adding water to those

[4]Kimball, H. H., and Hand, J. F., Investigations of the Dust Content of the Atmosphere, Monthly Weather Review, Vol. 59, Sept. 1931, pp. 349-52.

TABLE 2.—VARIATION OF DUST LOADING IN FLUE GASES FROM BOILER FURNACES WITH RATE OF BURNING COAL IN THE FURNACE.

	Dust Loading in Flue Gas, Grams per Cu Ft of Gas at 60F and 30 In. Hg. Pressure			
Firing Rate—pounds of coal per sq ft per hr.	15	25	35	45
Underfeed Stoker—bituminous coal	0.001	0.025	0.075	0.10
Chain Grate Stoker — anthracite screenings	0.005	0.020	0.050	0.12
Chain Grate Stoker—coke breeze	—	0.08	0.20	—
Firing Rate—thousands of Btu per cu ft furnace volume per hr.	10	15	20	25
Pulverized Bituminous Coal—tangentially fired	—	0.11	0.11	0.12
Pulverized Bituminous Coal—vertically fired	0.12	0.15	0.18	0.26

in which the level was too low. A pilot jar at the laboratory that could be observed daily was also used as a low water alarm to warn when jars in the field would most likely need additions of water.

When jars with funnels are set out, the need for initial liquid in the jars is not so great, since once dust is washed by rain or falls through the stem of the funnel into the jar, it is safe from loss by wind action. However, between rainfalls, all the dust which falls into the funnel does not, of necessity, find its way into the jar. What remains in the funnel is more likely to be re-entrained by the wind than equivalent material in a funnel-less jar, both because of the shape and shallowness of the funnel and the absence of a liquid trap at its bottom to retain the collected material. Experience has shown that funnel type soot-fall collectors are at the same time more fragile, more easily clogged by leaves and debris and more likely to be tampered with by children than funnel-less jars. Both type collectors require a stand to hold the jar or funnel top at least 3 ft above ground level. Both should be placed in open lots or on roofs free from wind eddies caused by adjacent buildings, copings, cornices or hills, and away from possible vandals.

Glass soot-fall jars and funnels have proven the most satisfactory despite precautions that must be taken against freezing. Wide-mouthed candy jars about 8 in. high have worked out well for funnel-less receptacles. In use a clean jar with fresh distilled water or anti-freeze is left in position for the next month when the jar exposed for the preceding month is picked up for return to the laboratory for analysis of its contents. This necessitates two sets of jars but avoids transfer losses in the field. The main analysis performed on the sample in the laboratory is weight of solid matter; other analyses such as loss of weight of sample on ignition or on extraction may be performed at the investigator's discretion.

Significance of Soot-Fall Data

Contrary to practice in measuring suspended impurity, the more soot-fall stations used, the more accurate the result. Decrease in cinder emission of a plant is immediately reflected by a decrease in soot-fall measured in cans placed near the plant. Since the cinder caught in the can is itself the nuisance to be abated, a direct measure of nuisance is obtained. It is important that enough cans be placed in each area so that nearby stations can check each other to detect erroneous individual samples. Because soot-fall cans measure local conditions, reports on city-wide soot-fall must be based on a large number of stations to be significant. Unfortunately many published reports are based on only one or two stations and are therefore misleading when reported and interpreted on a "tons per square mile" basis.

British practice is to divide towns into four pollution groups, A to D, depending on mean monthly soot-fall (Table 1). Reported studies show American cities classified according to total solids as follows:

A—none reported.
B—Washington, D. C. (1932), Salt Lake City (1920), Philadelphia (1934)
C—New York City (1936), Cleveland (1929)
D—Chicago (1936), Baltimore (1929), Pittsburgh (1929), St. Louis (1929).

The latter two cities are by reputation smoky and according to soot-fall data they have the highest monthly total solid deposition recorded in this country, 170 and 190 tons per square mile per month respectively.

Abatement of Dust and Cinder Pollution

The dust and cinder pollution most susceptible of reasonably effective abatement are stack and chimney emission of furnace flue gases or industrial process effluents. Abatement of the latter is achieved by uniformly requiring an efficient dust collecting system on all in-plant dust sources and further requiring that the air exhausted by each such system pass through an efficient dust separator before its discharge to the atmosphere.

Combustion of liquid and gaseous fuels contributes only a negligible quantity of the atmosphere's dust and cinder load. Solid fuels are the principal offenders. It should be obvious that combustion of pulverized coal results in loading the flue gases leaving the furnace with the major portion of the ash and unburned carbon in the coal (Table 2)[5]. The necessity of removing this fly ash from flue gases before discharge from the stack should be equally obvious as the logical means for abating pollution that would otherwise be introduced to the atmosphere.

Burning lump coal, partially in suspension as in spreader stokers, and on grates as in chain grate and underfeed stokers, results in the entrainment of cinder particles by flue gases. This entrainment increases with the rate of burning coal per square foot of grate area per hour (Table 2). With the upward air and gas velocity through the grate and furnace, it is greater for non-caking than for caking coals. Abatement may therefore be achieved either by using lower combustion rates, a better caking coal, a dust arrestor to clean up the effluent flue gases, or a combination of these means.

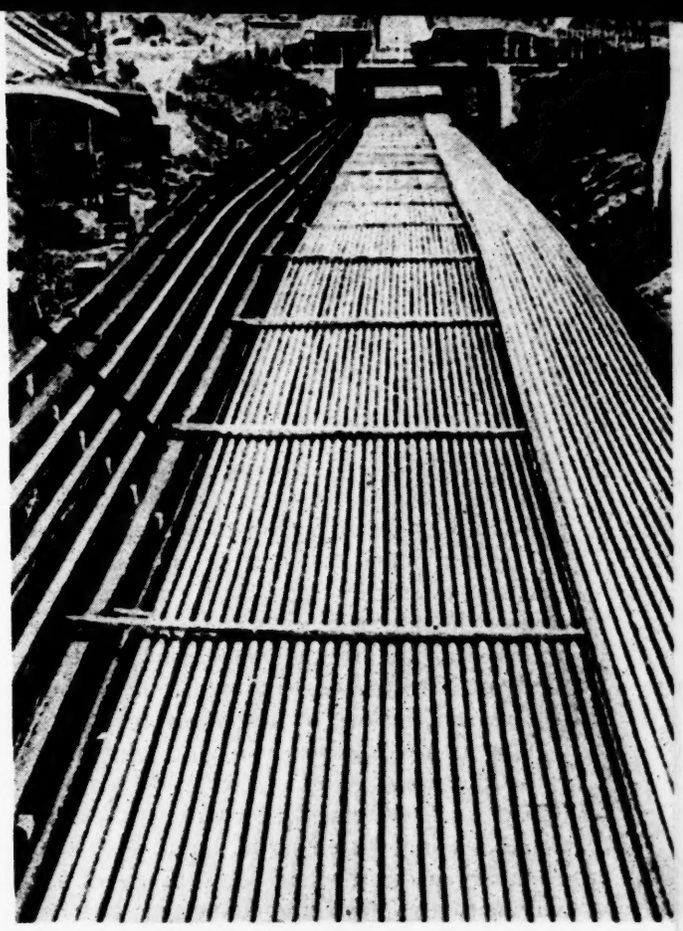
[5]Stern, A. C. The Measurement and Properties of Cinder and Fly Ash; Combustion, Vol. 4, No. 12; Vol. 5, No. 1; June-July, 1933, pp. 35-46.

OPERATION *Pluto*

20 PIPELINES UNDER THE CHANNEL

British engineers delivered two "impossible" solutions to Admiral Mountbatten's suggestion of a fuel pipeline from England to France.

All photos, Press Association, Inc.

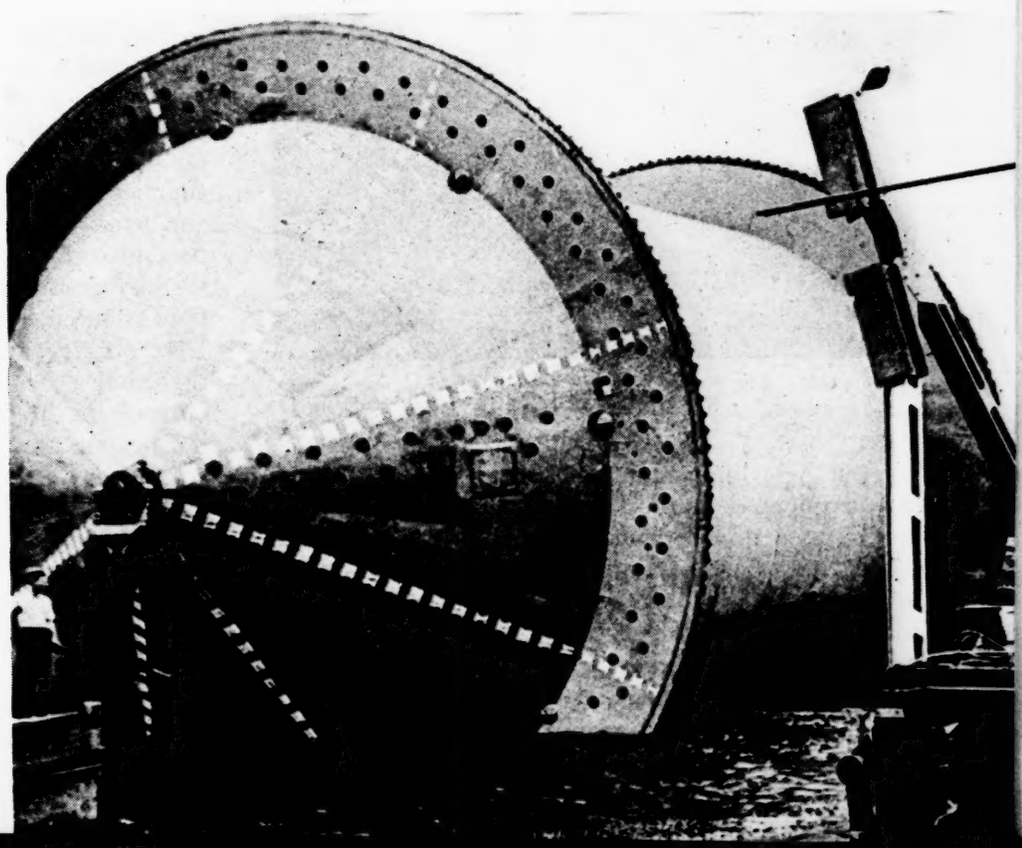


Two hundred miles of 3 in. steel pipe stored in 4,000-foot welded lengths. Designed for pressure of 12,000 lb per sq in. pipe will be wound on 40-foot drums for laying like cable. Eight of the 20 lines were of this type.

← British troops install T-union valve on first of 16 fuel pipelines to Boulogne from Dungeness. Four other lines from Isle of Wight to Cherbourg helped deliver 120,000,000 gallons of fuel to embattled troops between August 12 and May 23.

A. C. Hartley of Anglo-Iranian Oil Company suggested pipe like submarine cable without core or insulation. Made by Siemens & Henleys and called HAIS (Hartley-Anglo-Iranian-Siemens), pipes were carried in ship's hold in continuous lengths and fed out across control drums.

"H.M.S. Conundrum", a seagoing bobbin, being positioned for loading with steel pipe. These drums, 40 ft in diameter and 60 ft long, weighed 1,600 tons when fully wound. "Conuns" were towed across channel to lay continuous lengths of pipe 67 miles long.



Panel Layout and Coil Installation for Radiant Heating Systems

R. G. VANDERWEIL
Project Engineer, Chase Brass & Copper Co., Waterbury, Conn.

A NUMBER of heating mediums may be used for radiant heating systems. Snow melting panels are operated by steam or liquids of low freezing point; panels used in connection with comfort heating systems by hot water or vacuum steam. For comfort heating with coils embedded in concrete slab or plaster, the mean temperature of the heating medium is restricted to about 150F or less and for this reason the use of hot water prevails.

This article is concerned with comfort heating by embedded coils. Most phases of design and installation of such systems follow closely those of conventional heating systems and require little discussion. For this reason, this and the subsequent article treat only with the problems connected with coil layout and installation, pressure and temperature drop through coil and piping, and balancing of the system. Since good workmanship is considered essential for embedded coils, tube joining methods are discussed in detail.

Panel Layout

1. *Shape of Coils.* Various shapes of heating coils may be used. Fig. 1a shows the frequently used sinuous coil; Fig. 1b a header type coil applied only where low pressure drop or possibly constant panel surface temperature is required; Fig. 1c a coil fitting into round spaces; Fig. 1d into irregular room shapes. For economical reasons it is important to

Fig. 1. Shape of coils.

lay out pipe lines employing long, straight runs if ferrous pipes or hard copper tubes are used. With soft copper tubing, a minimum of soldered joints should be provided. For this reason it is desirable, in general, to build coils 1a and 1b in such a manner that the length l is larger than the depth d, and when using soft copper tubes, to design coils using not more than two to four regular lengths of tubing. (Annealed copper tubing is available in lengths of 60 to 100 ft.)

Last but not least, room comfort conditions will call for certain panel arrangements. In most cases it will be advisable to locate the panel close to the outside enclosures. This arrangement will not only heat the room air near windows and compensate for the influx of cold air by leakage, but will also cause an increase of the "mean radiant temperature" for objects or occupants located near the outside wall. The inner surface temperature of the outside enclosure is well below the room air temperatures, and with panels spread evenly over the entire floor or ceiling surface, the occupant will feel cooler near the outside wall. If, however, the warm panel and the outside enclosures are in close proximity, their combined radiation output is more nearly alike throughout the room.

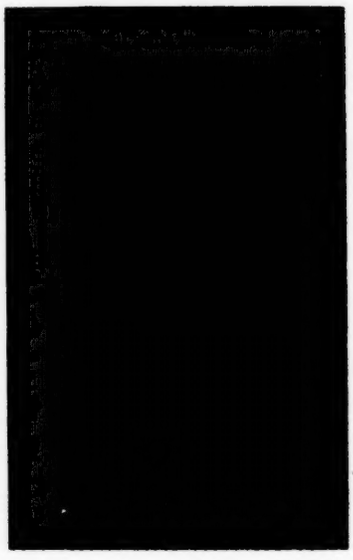


Fig. 2. Pipe and tube joints.

In general, it will be necessary to spread the heating coil over the entire ceiling or floor surface of the most unfavorable rooms (greatest heat loss and smallest available panel area). In all other rooms the coil may cover not more than ½ to ¾ of this surface. In *all* rooms, the hot water will be supplied to the coil at the outside wall (see Fig. 1a) and slowly cool down on its path through the coil, thus providing for a temperature gradient between the panel surface near the outside walls and near the inside enclosures.

According to previous reasoning, it is suggested that tube coils similar to Figs. 1c and 1d be used only where the heat losses are fairly well distributed throughout the room enclosures.

2. *Tube Connections.* Most ferrous pipes are joined by welding (Fig. 2a) and most copper tubing by 95-5 solder, although the use of silver-solder may, in the future, become more popular with ferrous pipes as well as with copper tubing. Proper silver-solder

EDITOR'S NOTE: This is the third article in a series by the author on radiant heating. Previous articles appeared in the April and June issues.

joints have a tensile strength equal to that of the materials joined and are presently used in connection with copper piping where high pressure conditions or high temperatures are met. Soft soldering is generally considered as a matter of routine, and so it is,

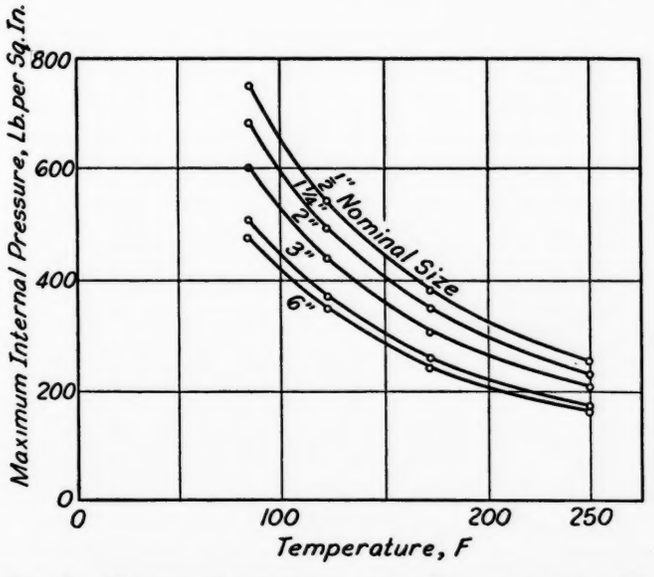


Fig. 3. Change of maximum operating pressure with temperature for 50-50 solder. Do not use for design. Graph from National Bureau of Standards, Building Materials and Structures, Report BMS 58, Strength of Soft Soldered Joints in Copper Tubing, and shows the test results for perfect joints.

if the proper precautions are taken. With radiant heating coils, the provision of good solder joints is considered essential and the engineer should be acquainted with the properties of joint and solder.

When soft soldering copper tube, the tube and inside of the sweat fitting should be thoroughly cleaned and a thin coat of flux applied to the cleaned parts. The fitting is slipped over the tube and the excess flux removed. The joint must be heated evenly and, when the flow point of the solder is attained, the solder is fed to the gap between the sweat fitting and the tube (Fig. 2b), and is drawn up into the space between the tube and fitting by capillary attraction. When a line of solder shows completely around the edge of the fitting, the connection is complete. Finally, all surplus solder is removed from this edge by a brush. This operation will show whether or not the solder has filled the joint. The joint must be allowed to cool before placing any strain on it.

One of the reasons why copper tube of small diameters may be used for heating coils is the neat tube connecting procedure. No excess solder decreases the cross sectional tube area at the joint. Also, the smooth surface of copper results in a lower coefficient of friction and copper forms no rust scale to clog the line or deposit in the practically horizontal coils, and decrease their heat output. When selecting the solder, it is well to know its physical properties. All solders decrease in strength with increasing temperatures, as may be seen in Fig. 3, giving the maximum allowable internal pressure for tubing joined by 50/50 tin-lead solder. (This solder is not recommended for use on radiant heating piping because of its low tensile strength at the operating temperatures of the system.)

For practical purposes and in order to allow for imperfections in the joining process, a lower working pressure must be selected (see Table 1). With soft solders, just as with silver solders, the joint properties are best with a relatively small solder layer (.001 to .003 in.) and the commercially available tubes and fittings allow for a clearance of approximately .002 in.

Table 1 compares the allowable working pressure in pounds per square inch for various solders. With soft solders, this pressure is restricted by the shear strength of the joint rather than by the tube strength and the maximum pressures are the same for types K, L and M tube.

One of the questions asked by those little acquainted with heating systems is: What are the remedies against leaks in the coil? Although the author has not yet encountered a leaking coil, he would like to discuss what seems to be a subject of general interest. First of all, a properly *installed* and *tested* coil, properly *operated*, will likely outlast the building. But, leaks may occur in any heating system if, for instance, the piping were not drained and consequently froze during the winter.

If the panel is located in the ceiling, the leak may be readily found and repaired. With floor panels, the leaking water may follow the path of least resistance and the wet spot on the ceiling below may appear several feet removed from the actual leak, in which case, locating the leak is more bothersome. With panels on dry ground, the discovery of a leak may present a problem. No indication other than the loss of water may point to the presence of a leak and, for this reason, it is advisable to indicate the actual location of all welded or soldered coil joints in the final construction prints. In rooms where valuable equipment is located, special care should be taken to avoid damage to tube during installation and soft copper tube should be used, having 1/3 to 1/10 the number of joints of hard copper tubes or ferrous pipes. Also, the end of the first tube run may be extended to the wall and con-

TABLE 1. — MAXIMUM ALLOWABLE WORKING PRESSURES FOR COPPER TUBING.

Diameter, Inches	Material				
	95 Tin/5 Antimony		50 Tin/50 Lead		Silver Solder
	Temperatures				
	up to 150F	up to 200F	up to 150F	up to 200F	up to 250F
	Max. Allowable Working Pressure, Lb. per Sq. In.				
Up to 2 in. nom.	630	470	120	95	—
⅜ in. Type K					1780
L					1470
M					950
2 in. Type K					750
L					640
M					530

nected to the next run within the wall or wall furring rather than within the ceiling or floor area proper. Another, less economical, layout for such rooms is to provide several individual coils not longer than the 60 to 100 feet tube run.

3. *Tube Dimension and Distance Between Centers.* When laying out radiant heating panels, a number

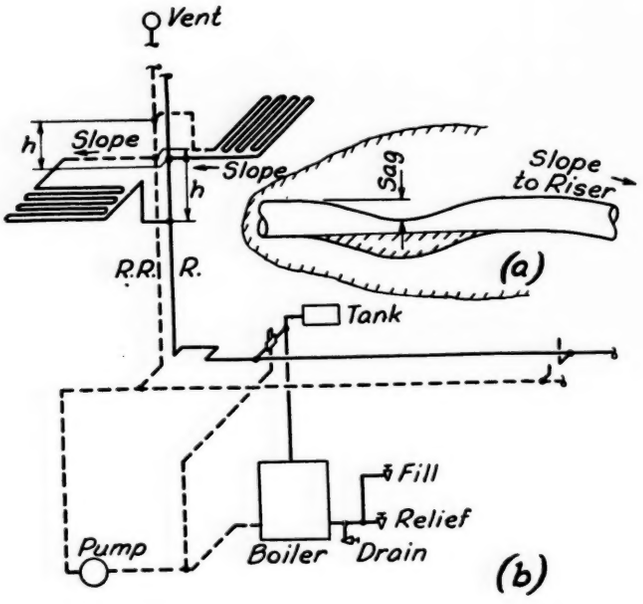


Fig. 4. One scheme for proper drain and venting.

of combinations of water temperature, tube spacing, and tube diameter may be computed, all of which result in the desired panel heat output. Having to select between these possible combinations, the designer should give consideration to the following.

In floor panels, the surface temperature is generally restricted to 85F. In a great number of such panels, the tubes are covered by layers of *low heat conductivity* such as linoleum, wood flooring, etc., which result in a small temperature gradient between the parts of the surface located directly above the tubes and the parts of the surface between tube centers. (See Fig. 2, page 70, June, 1945, HEATING AND VENTILATING.) For this reason, it is possible to use the more economical larger tube spacings. Hand in hand with larger spacings, slightly larger diameters are used. In *high conductivity* panels, such as plain concrete slabs, and where the depth of tube cover is not great, it is advisable to restrict the pipe spacing to 12 in. or less in order to avoid great temperature variations between the various points of the floor surface.

In most ceiling panels, the dimension governing the coil layout is the plaster thickness. According to U. S. building practice it will be necessary to use ⅜ in. nominal round or ½ in. oval tubes, or otherwise to increase the depth of plaster to provide for proper tube cover for ½ in. or ¾ in. nominal tube or piping. It is interesting to note that, due to different building practice (heavier plaster layers), one of the foremost continental manufacturers of steel pipes suggests the use of ½ in. and ¾ in. pipe almost exclusively for ceiling panels. As with floor panels, the selection of larger tube spacings in connection with higher water temperatures will prove economical although with the tube spacings of approximately 12 in. and over, the efficiency of the panel decreases slightly. This is due to the fact that the tube cover is very shallow and that the heat conductivity of the plastered ceiling surfaces is relatively low. For these conditions, the temperature of the surfaces located half way between tube centers, and therefore the panel's heat output, decreases with very large spacings.

The heat flow conditions of the wall panel are essentially like those of the ceiling panels.

4. *The Drain and Vent Problem.* Because of the long level tube runs installed in radiant heating systems, the designer should study this problem in each individual case. In order to drain the tubes, the coil of floor and ceiling systems should be designed to be level. Floor coils located in a thick floor structure may be laid out to drain to a certain low point but the slope will still be small. Although gravity and siphon action provide for sufficient draining of properly installed level coils, it has been suggested to use compressed air to blow such systems dry. When draining with compressed air, each coil must be flushed individually and for this reason a valve must be installed in each coil connection.

Gravity draining is used in the majority of buildings but functions properly only if the coils are sufficiently level. In practice it is nearly impossible to install level coils; however, if the maximum sag of ⅜ in. nominal tubes is less than ¼ in. and that of ¾ in. tubes is less than ½ in. (see Fig. 4a) the draining properties of the coil may be considered as sufficiently safe. Since water, when freezing, expands roughly 1/10 of its volume, tubes installed according to previous recommendations will provide sufficient expansion space for any ice formation in the sagging points of the coil.

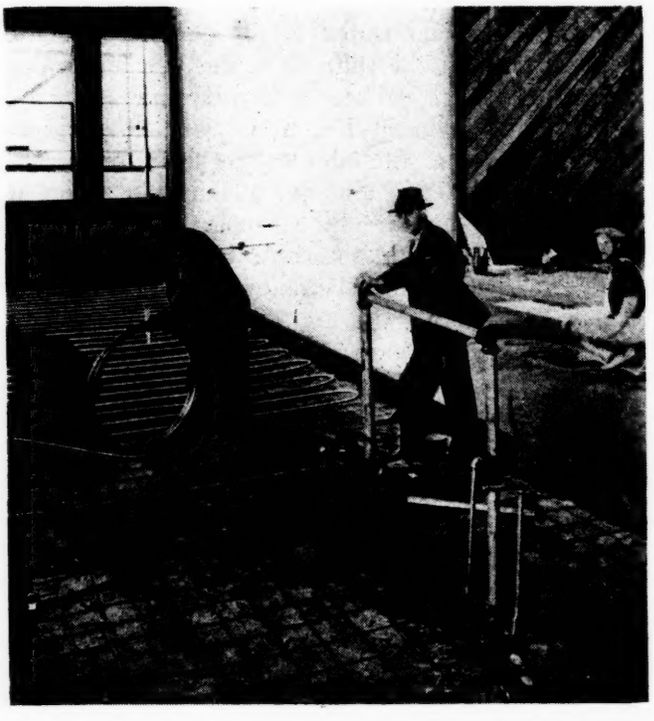


Fig. 5. Forming sinuous copper coils. By working on every other panel interference between trades is reduced.

So as to take better advantage of the gravity action, panel connections as indicated by Figure 4b could be used to advantage. The return connection is located at a slightly higher level than the riser connection. This arrangement provides for a directional flow whenever the system is drained.

Closely connected with the problem of draining is the vent problem. Arrangement according to Fig. 4 will also greatly facilitate uniform venting; in fact, due to the continuous slope of the coil connections, it will prove sufficient to install automatic vents at the top of the return riser only, and omit such vents on the supply riser. Fill and drain line, according to this scheme, are connected at the boiler. In Fig. 4 the difference of elevation h should be 3 in. or more, or sufficient to provide for a continuous slope in the coil connection. However, h should not be of too great a magnitude in order to use to full advantage, the gravitational forces acting when the system is heated.

5. *Cost of Installation.* It was noted that with certain limitations, the primary investment increases with decreasing pipe or tube spacing and water temperatures. In ceiling panels, the selection of a proper tube diameter is of great influence upon the installation cost. Once tube diameter and spacing are fixed, the primary investment is affected by the choice of tube material—steel, wrought iron, or copper—and by the cost of labor.

When using copper, it is obvious that the installation cost is greatly reduced with annealed tube. Since little effort is required for bending, and the tube is supplied in lengths of 60 to 100 ft, the time required for coil forming and assembly is reduced to about 60% of that required for hard copper pipes.

A general comparison of the installation cost of conventional and radiant heating systems cannot be made. Each case will have to be studied individually. However, from previous experience, it can be stated that the difference in primary investment is surprisingly small—plus or minus 10%—in most cases.

Coil Installation

The installation procedure for hard copper tube is similar to that for ferrous piping and the discussion will be restricted to annealed copper tube.

1. *Forming and Assembly of Coils.* The forming

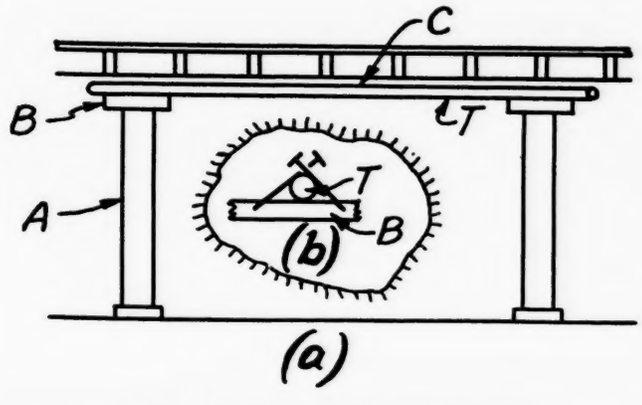


Fig. 7. Installation of ceiling coils.

Fig. 6. Jig for bending soft copper tubes.

and bending of the coils is quite simple and is shown by Fig. 5. One man lays out and bends the tube to whatever shape is desired and is assisted by another, who supports the coiled copper roll. Eventually the job can be handled by a single man as shown in Fig. 6, which also indicates a simple jig frequently used to avoid irregularities in the bending radius of the copper tube. Again the tube is shaped by hand to fit into the semi-circular fixture. Wherever one tube coil (roll) has to be jointed to another, the tube ends of both rolls are lifted to an easily accessible position, cleaned and connected. Compared with the soldering procedure of the stiff, hard tempered copper pipe, this represents a distinct advantage. Bottom and top of joint are readily accessible for soldering as well as for visual inspection.

2. *Attaching the Coils*—Floor Panels. No special attachment is requred if the concrete covering the tube is poured under supervision of the heating contractor immediately after the coil is formed and tested. Supports are necessary at points where the tube may sag and generally with coils where the concrete slab is not finished immediately after completion of the coil. Such supports are provided by small lumps of cement, covering the tube and attaching it to the lower concrete slab, which are favorably located near the bends. Where the coils are located on top of steel reinforcing mesh as in Fig. 5, the tubes are wired to the mesh.

Ceiling Panels. Coils of few bends and with long straight runs may be laid out directly on the ceiling, similarly to the floor coil. One man attaches the tube with pipe straps—spaced 2 to 3 ft apart—and forms the bends wherever required. He may be assisted by a second man holding the rolled copper coil.

With larger panels, it is advisable to form sinuous

coils on the floor and place two boards (or whatever available; e.g. 1 x 6 tongue and groove sheathing) under the coil, so that one board supports all bends on one side of the coil and the second board supports the bends on the other side of the coil. In order to facilitate the lifting of the coil, it should include not more than 250 to 300 ft of ⅜ in. nominal copper tube.

After the tube *T* of Fig. 7b is temporarily tacked to the boards *B*, one man stands at each end of the panel and lifts his board with one hand, high enough to insert the prop *A* and then to lift the coil to the ceiling as shown in Fig. 7a. Next, two more supports *A* are inserted, and starting from the center *C* of Fig. 7a, the tubes are attached under the lath and to the joists or furring strips by means of pipe straps. Finally, supports *A* and *B* are removed and the ceiling is ready for application of the plaster. A different system is used by Robert Bruen. He attaches the tubes to V-rib metal lath (patent applied for) and installs lath and tube sumultaneously, as will be illustrated in the next article of this series.

Wall Panels. These panels are mostly small enough to be laid out on the floor and lifted by hand, and without further preparation to their location. Only when large wall panels are installed is it necessary to either use a similar method as described for the ceiling panels, or to string together the parallel straight runs, before the coil is lifted to the wall. Once the coil is located properly, it is again attached by pipe straps.

Ceiling Coils in Concrete Slabs. If embedded in the slab, these coils are bent to proper shape and laid out directly on the concrete forms of plastered ceilings. With painted ceiling, the coil must be embedded deeper in the concrete, and for this reason small removable wooden blocks or metal inserts ¼ in. or higher are placed between concrete form and coil. Wood inserts are removed before the ceiling is finished and painted.

Where ceiling panels are installed in a plaster layer underneath a concrete slab, the procedure is much like that used in frame structures. For tube attachment, small lead expansion shields may be inserted in the slab and the pipe straps screwed to the shield.

The methods described by no means represent universal installation practice. Actually the procedure of installation changes not only with the structure but also with the number of men and equipment available for erection. For instance, it is not objectionable to lay out and assemble large and heavy ceiling coils if, as is likely in larger building projects, the proper equipment is available to lift the coil to the ceiling.

3. *Protection of Tube.* No protection against falling objects is required for ferrous pipes and hard copper tube. Although reasonable care should be taken in handling annealed copper tube, no protection is required if it is installed in heating panels of frame structures. Also, coils installed in floor panels of one- or two-story masonry buildings are little exposed to falling objects and it is not customary to provide for protection. The tubes are damaged only if directly hit by heavy or sharp edged objects and easily withstand the pressure of concrete buggies with rubbers tires.

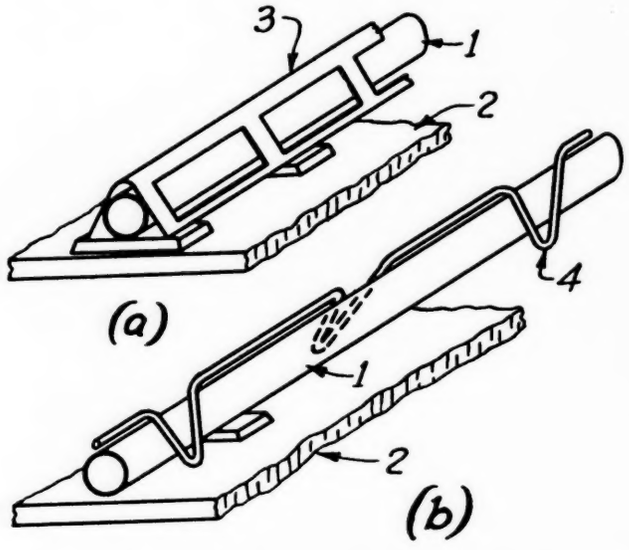


Fig. 8. Alternate protection of copper coils in special structures.

In multi-story buildings, and where the coils are laid out before the concrete slab is poured—skeleton construction—protection may be provided if soft copper tube is used. Two of several possible protective devices are indicated in Fig. 8, where a section of a ceiling coil is shown located at the concrete form 2. In Fig. 8a a light, pre-bent and stamped sheet metal section 3 is used for protection. It is loosely laid over the tube. In Fig. 8b a pre-bent heavy wire or light reinforcing rod serves the same purpose.

Since protection is desirable in multi-story steel frame structures only, and in such buildings a great number of cover plates (3 of Fig. 8) or cover rods (4) will be required, these protecting members may be manufactured at a low cost. Thus it may prove more economical to use soft tube, also in such buildings, because the increased labor cost connected with bending and soldering of hard tube will outweigh the price of the protecting device.

4. *Inspection and Testing of Panels.* All coils must be tested shortly before the concrete is poured or before the plaster is applied. For level coils, it is most important to make sure that coil inlet and outlet are of same elevation and that at no point the coil sags for more than two-thirds or, better, one-half of the tube I. D. With sloping coils, the pitch should be carefully checked. In all cases sagging points must be straightened or supported. The inspection must show that at no point has the tube been seriously deformed and the tube cross section decreased. If a damaged section should be found, it has to be removed and replaced by an appropriate length of tube, by the usual joining process.

Pressure Test. Each coil should undergo a hydraulic pressure test before it is finally buried. When filling the tube, care should be taken that all air can escape from the coil. The coil should be

exposed to a testing pressure of 300 lb per sq in (see Table 1 and Fig. 3) and thoroughly checked for leaks. In high buildings the testing pressure should exceed the combined static and pump pressure by 100 lb per sq in. After two or three hours the coils are drained but not before the testing pressure is checked.

No pressure drop due to leaks should occur during this short period. In order to *accurately* check pressure drops due to loss of water it is—at least theoretically—necessary to take into consideration the pressure rise of the system caused by the eventual rise of temperature of the water during the testing period. Practically this is not customary, but in order to minimize the increase of test pressure by temperature changes, test-water of nearly room temperature should be used, if available. If, during the summer months, the temperature of the water is cooler than the room temperature, the test should possibly be performed during the early morning hours when the panel structure is relatively cool.

5. *First Heating Period.* After all concrete or plaster panels are cured, the system is ready for its first heating period. It is desirable, at the start of this period—or of an eventual operating test—not to use design water temperature but rather to run the system on a low temperature for 24 to 48 hours and slowly step it up to the maximum operating temperature. After this initial operating period, rapid variations of the water temperature will not affect the panel.

EDITOR'S NOTE: *Next month Mr. Vanderweil will discuss the piping system and automatic controls for radiant heating systems.*

After the Horse is Stolen

JOHN J. WOOLFENDEN

Engineering Staff, Smith, Hinchman & Grylls, Inc., Architects and Engineers, Detroit, Mich.

THE "old saw" about locking the barn after the horse has been stolen, is too often brought to mind by occurrences within the range of our own experience.

One such instance, for which the writer is glad to say he was not responsible, occurred several years ago and left such an impression that most of those familiar with the results are "gun shy" when similar conditions are encountered.

An extensive addition was being made to a good-sized heating system and, owing to the necessity of certain of the new apparatus functioning in close conjunction with the similar parts of the existing installation, many cross-connections between the new and the existing piping were necessary.

The building work was nearing completion; in fact, some portions of the new structure had been opened up for the owner's use.

Work on the steam piping was well along, but several branch mains were yet unfinished. Except for water heating and for the drying out of the less advanced portions of the building, steam was not required, as it was late summer and the weather was warm and dry.

One morning, a report was received that the janitor had found two rooms full of steam and that the varnish on the woodwork in these rooms had been "cooked white."

Investigation disclosed that, when the steamfitters had stopped work the previous day, they had left the radiator connections in these rooms with open ends. They had, however, closed the steam valve in the new piping supplying the branch main for that portion of the building and had locked it in position with padlock and chain.

Unfortunately, some of the cross-connections had been installed and one of these, which connected to the new piping downstream from the locked valve, was in a rather out-of-the-way location and had been overlooked. This connection was not valved, itself, but was valved from an existing branch main which was controlled by a valve upstream from the point of connection.

For some reason, steam was required in this branch main during the night and somebody had opened the valve in the existing system. This, of course, also admitted steam to the branch of the new piping through the by-pass formed by the cross-connection whence it escaped into the building through the open ends.

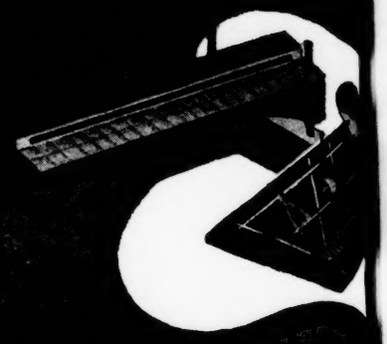
Since that time, the writer had made it a practice never to depend solely upon a valve to stop an open end, but has insisted, in all cases, that all openings downstream from the stop valve be properly capped, plugged or provided with blind flanges, as required, whether for temporary or permanent conditions.

Work supposedly interrupted for a day or two may not be resumed for a week or more; valves sometimes leak and also, especially in a new installation, someone not thoroughly familiar with the system may open the wrong valve.

Installation of a few caps, plugs or flanges is cheap insurance and will cost far less than the repair of damage because they were not used.

A very dangerous situation is that of a man working inside a boiler which has been shut down but is still connected to the line. Many men have been scalded, often fatally, by the steam admitted to a "dead" boiler as a result of the opening of the stop valve in the boiler steam connection. At the present time, the usual code requirements call for an automatic stop and check valve on each boiler connection where more than one boiler is connected to a common header—at least in the case of high pressure boilers —and this in addition to a gate valve.

REVIEWS



Articles are abstracted for the convenience of the readers. Orders cannot be taken for the full length articles. Those desiring to obtain copies of the article referred to should write to the publishers of the respective articles.

ELECTRONICS

One of the scientific mysteries, accentuated by war developments, has been electronics. By far most of the books published on the subject are so involved in mathematics and equations that the subject still continues to be a mystery to all except those with a good background in physics and electrical engineering.

John Mills, in his "Electronics Today and Tomorrow," has brought electronics down to an understandable level, He is to be praised for taking a difficult subject and explaining its principles so that the average reader can grasp what it is all about. Mr. Mills, formerly of the Bell Telephone Laboratories technical staff, has written a number of books on electrical science. His style is to be commended. The actions of the electrons, the operation of the tubes, and the descriptions of their applications are so tied in with common every day things, that a layman soon becomes enthralled in the subject. However, it is not a book for an advanced student or one who has had a good background in electrical engineering.

There are three parts to the book—electrons, in which the principles are described; electron tubes, which covers vacuum and gas-filled tubes; electronic devices, which describes television, electron optics, ultra-high frequency and cyclotrons.

Cloth bound, 5½x8 in., 178 pages. Published by D. Van Nostrand Co., Inc., 250 4th Ave., New York, N. Y. Price, $2.25.

BLUEPRINT READING

The subject of "Building Trades Blueprint Reading" is covered in two spiral bound paper-cover books—part 1 on fundamentals and part 2 on specifications and blueprints. Written by J. Ralph Dalzell, head, Architectural Engineering Department, American School, and Managing Editor, American Technical Society, the books are planned for the building trades apprentice. The material is arranged in an easy step-by-step method.

While the two volumes may be purchased separately, the book on specifications and blueprints does presuppose some knowledge of blueprint reading. The text is easy to follow and is very well illustrated.

Building Trades Blueprint Reading by J. Ralph Dalzell. Paper covered, spiral bound, part 1 contains 138 pages; part 2, 234 pages and several folded blueprints. Published by American Technical Society, Drexel Ave., at 58th St., Chicago 37, Ill. Price, $2 each part.

HIGH FREQUENCY INDUCTION HEATING

The use of induction heating has made possible exact control of heat treatment of metal, and the prediction is that it will have an important bearing on product design and manufacturing processes.

A broad coverage of heating coils and fixtures, as used in hardening and joining operations, is presented by the author, who has had considerable experience in this field—with the Van Norman Co., and now as consulting engineer for the Induction Heating Corp.

This book is recommended for its large amount of factual information and for its simple explanations. Even though this subject is associated with electronics, the book is divorced from the highly technical presentations too common with electronic material.

A short chapter is included on dielectric heating mainly to show the difference between these two methods of heat transfer. After presenting the elements of induction heating, Mr. Curtis takes up the design of induction heating coils; brazing, soldering and joining; hardening and heat treating; fixtures for induction heating; and applications.

High Frequency Induction Heating, by Frank W. Curtis. Cloth bound, 5½x8½ in.; 235 pages. Published by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 18, N. Y. Price, $2.75.

HYDROGENATION OF COAL

The effect of variations in temperature at a pressure of 1,000 lb per sq in, the effect of variations in pressure at a temperature of 1,050F, and the effect of variations in temperature at 5,600 lb per sq in, were studied at the Engineering Experiment Station, Purdue University, and the equilibrium conditions were noted. In their report, J. L. Bray, Head, School of Chemical and Metallurgical Engineering, and P. W. Morgal, Associate, Engineering Experiment Station, describe the technique for the high pressure autoclave. When the shortage of manpower and strategic materials lessen, this study will be continued.

The purpose of the research is to develop a process to supply a gas of high calorific power from coal—a manufactured gas comparable to natural gas. The study is looking ahead to the time when the natural gas reserves will be depleted. No other conclusions than those made in Report No. 1 can be made at this time. This bulletin is the second of a series having to do with the hydrogenation of coal with special reference to Indiana Coal.

Bulletin No. 93, report No. 2, paper covered, 6x9 in, 36 pages. Published by Engineering Experiment Station, Purdue University, Lafayette, Ind. Price, 15c.

BRIEF REVIEWS

SELECTION OF STOKER EQUIPMENT—Consolidated table on load carrying capacities, minimum furnace dimensions, draft and chimneys for typical single retort underfeed stokers. It is the second edition of the revised May 1945 table issued by the Stoker Manufacturers Association. There are no changes in the basic and fundamental data although there are changes to improve its appearance. Price, 5 cents. Copies may be obtained from Stoker Manufacturers Association, 307 N. Michigan Ave., Chicago 1, Ill.

ASBESTOS—A 16-page bulletin describing briefly but adequately the various methods employed in mining asbestos. The author is C. V. Smith, Johnson's Company, Thetford Mines, P. Q., Canada. Obtainable from "Asbestos," Philadelphia, Pa. Price, 25c per copy.

(Concluded on page 126)

NEWS OF THE MONTH

Kinkade Addresses ASRE

RICHMOND, VA.—"Evaporative Condensers provide efficient and economical condensing of refrigerants, utilizing small space, use of little water, and a minimum of vibration," according to H. J. Kinkade, contract products division, Young Radiator Company, Racine, Wis., in a talk before the local section of the American Society of Refrigerating Engineers here May 7. In his talk "Methods of Condensing Refrigerants" three different types of condensers were discussed: air cooled condensers, shell and tube condensers, and evaporative condensers.

REMA Elects Hood

CHICAGO—F. J. Hood, vice-president of the Ansul Chemical company, Marinette, Wis., was elected president of the Refrigeration Equipment Manufacturers Association at a meeting of the new board of directors here May 24. He succeeds Arthur B. Schellenberg, president of the Alco Valve company, St. Louis, Mo., as head of the association.

Other new officers chosen at the meeting were H. F. Spoehrer, Sporlan Valve company, St. Louis, vice-president; Edward M. Flannery, Bush Manufacturing Company, Hartford, Conn., secretary; and J. A. Strachan, Weatherhead company, Cleveland, treasurer. R. Kennedy Hanson continues as executive secretary with offices in the association's general headquarters in Pittsburgh.

The new directors of the organization, meeting for the first time, include the new officers and Mr. Schellenberg; R. H. Luscombe, Penn Electric Switch Co., Goshen, Ind.; C. H. Benson, Imperial Brass Mfg. Co., Chicago; W. H. Maxwell, Wolverine Tube Division, Detroit; R. O. White, Day and Night Mfg. Co., Monrovia, Calif.; Guy J. Henry, Henry Valve Co., Chicago; B. J. Scholl, Brunner Mfg. Co., Utica, N. Y.; Philip T. Miner, Tyler Fixture Co., Niles, Mich.; and M. R. Oberholzer, L. H. Gilmer Co., Philadelphia.

This year marks the tenth anniversary of the organization of the Refrigeration Equipment Manufacturers Association.

Schools Test Ultra Violet Rays

ALBANY, N. Y.—Two central New York schools have been equipped with ultra violet lamps to determine the value of ultra violet rays in combating airborne bacteria. The tests are being made in Cato-Meridian and Port Byron Central Schools, Cayuga County, while at the Mexico Central School, Oswego County, a record on health and ventilation will be kept as a basis for comparison.

Chimney Committee Formed by ASA

The American Standards Association is making an extensive study of building code requirements to increase safety to persons and property. A Subcommittee on Chimneys and Fireplaces, which has been instructed to develop construction codes and specific performance requirements for chimneys, fireplaces, smokepipes, and dampers, has been organized. Dr. H. J. Rose of Bituminous Coal Research, Inc., is chairman.

A progress report submitted at a recent meeting of Committee A52 emphasized new chimney problems resulting from recent trends in housing design and new materials of construction. Much additional engineering information is needed to write satisfactory codes. Government research now in progress is supplying some of the information needed.

A. C. Aids Wacs' Morale

WASHINGTON—The air-conditioning of hospitals and of nurses' quarters in abnormally hot climates is not so much a matter of luxury as one of necessity and efficiency, Maj. Margaret D. Craighill declared June 24.

She had just returned from an eight-month trip abroad during which she made an inspection of the facilities for members of the Women's Army Corps and of the Army Nurse Corps. At a press conference at the Pentagon Building she said that operational chiefs in the Pacific area should follow the example at Teheran, where all hospitals and nurses' quarters under United States control were fully air-conditioned.

"Army women stood their second summer on the Persian Gulf much better than the first because of a different psychological approach," she said. "When they found out that the heat was not much worse than Washington they forgot about their emergency teams for heat exhaustion, learned to take long siestas, frequent drinks from fluid carts, and salt tablets. But air-conditioning was the greatest boon, and reduced fatigue enormously. I do hope some of these lessons learned in the Persian Gulf will be carried out in the Pacific."

Major Craighill flew 56,000 miles on a route that included England, France, Italy, the African Gold Coast, Egypt, Iran, India, China, New Guinea, the Philippines, Australia and Hawaii. She went by jeep and amphibious "duck" where airplanes could not take her. As the result of her health inspection, she declared that fears about what either cold or tropic climates might do to American women were unfounded and that their health has been much better than had been expected.

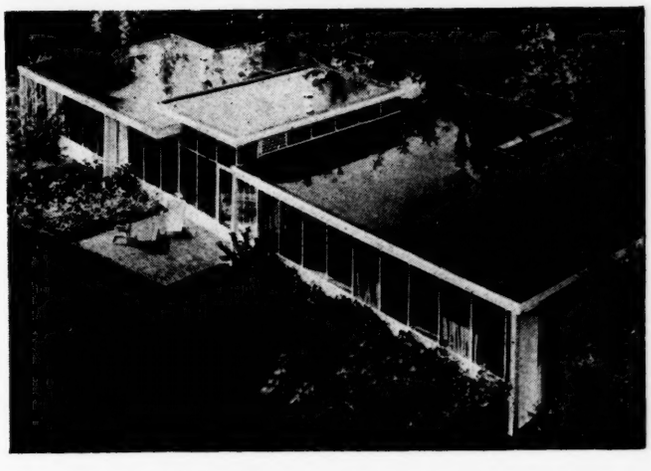
Women on the whole have done better than the men from a health point of view, due to the fact that they had got a better "break" in living conditions.

Radiant Heating for Modern Houses

NEW YORK—An exhibit of eight three-dimensional models of modern houses is on display at the Museum of Modern Art here until September 3, in an exhibit entitled "Tomorrow's Small House".

In all of the eight houses the designers rejected cellars and attics and specified concrete floor slab foundations with radiant heating built into the floor.

The houses were originally designed and constructed for the *Ladies Home Journal*, which has lent them to the Museum.



Water on the roof reduces sun heat gain in summer, radiant heat is provided for winter, and louvers beneath the windows provide cross ventilation in this house designed by George Fred Keck, one of nine models on display at the Museum of Modern Art, New York, in an exhibit entitled "Tomorrow's Small House."

ASHVE Establishes Library

NEW YORK—The establishment of the John R. Allen Memorial Library by the American Society of Heating and Ventilating Engineers, has just been announced. It is planned that this library of books, phamphlets, and other printed matter dealing with the arts and sciences of heating, ventilating and air conditioning will be located in the society's research laboratory.

Because of his pioneer work in the establishment of the A.S.H.V.E. Research Laboratory and as its first director, it was considered fitting by the Committee on Research that the Library should commemorate the memory of John R. Allen. He served as president of the Society in 1912 and became active head of the society's research laboratory at the Bureau of Mines, Pittsburgh, Pa., on August 1, 1919.

Pipe Covering Ban Removed

WASHINGTON, D. C.—The ban on 85% magnesia pipe covering has been removed from the Army and Navy Munitions Board's Revised List of Prohibited Items for Construction Work. The new list contains no restrictions on magnesia.

Previously, the Army and Navy Munitions Board restriction prohibited the use of 85% magnesia in installations where operating temperatures were under 212F, except on installations buried in the ground.

REMA Starts Educational Program

PITTSBURGH—New and ingenious uses of mechanical refrigeration and air conditioning during the war, many of them unknown to the public, will result in undreamed of applications in the household, commercial and industrial fields when peacetime production is fully resumed, according to a prediction by F. J. Hood, newly elected president of the Refrigeration Equipment Manufacturers Association.

"In view of this encouraging situation, the Refrigeration Equipment Manufacturers Association has embarked on a new program which has the three-fold purpose of coordinating the industry to promote its best interests, of presenting a unified front to the public, and of selling the public on the advantages of modern mechanical refrigeration and air conditioning."

Mr. Hood, vice-president of the Ansul Chemical Company, Marinette, Wis., is one of the founders and a charter member of REMA which this year is observing its tenth anniversary with more than 75 member companies.

Headquarters of the Refrigeration Equipment Manufacturers are in the Clark Building, Pittsburgh, Pa.

New officers of the Refrigeration Equipment Manufacturers Association, elected at the first meeting of the new board of directors in Chicago. Left to right: F. J. Hood, Ansul Chemical Co., president; H. F. Spoehrer, Sporlan Valve Co., vice-president; Edward M. Flannery, Bush Mfg. Co., secretary; and J. A. Strachan, Weatherhead Co., treasurer.

ASRE Council Meets

NEW YORK—Chairmen or appointed representatives of each of the 21 local sections of The American Society of Refrigerating Engineers were present at a meeting of the organization's Sections Committee held June 11 in the Hotel Gibson in Cincinnati. At this session, presided over by William S. Woodside, chairman of the committee, improved methods of conducting section affairs were discussed in detail. The executive and finance committees of the society also met on the same day.

At the A.S.R.E. Council meeting, held the following day, John F. Stone, national president of the society, presented a charter to the chairman of the new Connecticut Valley Section, A. W. Towson.

Since ODT regulations made it impossible for the society to hold its usual Spring Meeting, six technical papers usually presented at such a meeting were published in the society's magazine. No definite action was taken on the time or place of the 41st annual meeting.

Burner Engineering Committee Meets

NEW YORK—The engineering committee of Oil-Heat Institute of America held a one-day meeting here June 19. Reports received from laboratories engaged in making burning tests on catalytic fuel oils indicate that all but two have completed these tests and are now recording results. It is expected that by April 30, 1946, all laboratories' reports will be received at the OHI offices where the correlation will be done.

After further discussion of the proposed OHI Combustion Reference Test Unit, it was agreed to proceed with the preparation of detail drawings and take bids for the construction of the first unit on or about August 20. The unit will have the same value to the oil heating industry as the Waukesha engine has to the automotive industry.

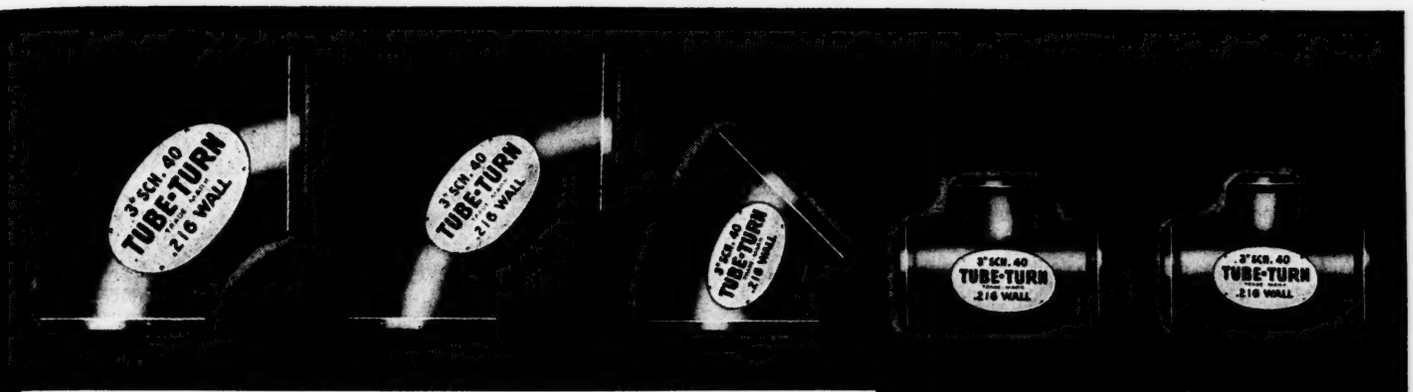
The engineering committee for 1945, recently announced by President Matheson, will again have Frank Faust of General Electric Company of Bloomfield, N. J., as chairman. Other members of the Committee are: Messrs. W. A. Bulger (Petro), J. C. Hauf, Jr. (Quiet May), L. N. Hunter (National Radiator), Edwin Jones (Chrysler Airtemp), H. C. Jones (Delco), J. A. Logan (Gilbert & Barker), E. O. Nesmith (Oil-O-Matic), P. M. Nigro (Torrington), Stanley Perry (Oil Devices), M. A. Powers (Timken), and A. W. Ruff (York-Shipley).

Mineral Wool in 1944

WASHINGTON—Mineral wool production in 1944, as reported by producers to the Bureau of Mines, reached 568,296 short tons valued at $54,482,796, an increase of $10,812,086 in value and 16,772 tons in quantity over the 1943 total. The production of home and industrial insulation increased, but the greatest change occurred in the industrial field.

The advance in industrial insulation is attributed to the larger requirements of the armed forces for mineral wool insulation products on ships, aircraft, tanks, and other military equipment, and the realization by industry that complete insulation is necessary to maintain maximum efficiency and production during the war period.

The large increase in dollar value is attributed to the amendment of Order A-2 of Maximum Price Regulation 188, effective from September 16, 1943, granting relief to mineral wool manufacturers to cover increased manufacturing costs, and the larger production of the relatively higher cost industrial insulation. Prices in 1944, per short ton, in carlots f.o.b. plant were $37.50 for loose and $53 for granulated wool, compared with $30 and $45 respectively in 1943.



TUBE-TURN

TRADE MARK

WELDING FITTINGS AND FLANGES

TUBE-TURN WELDING FITTINGS—RANGE OF SIZES

Type of Fitting	Description	Standard Weight	Extra Strong	Schedule 160	Double Extra Strong	Light Gauge	
						Nominal Pipe Size	Iron Pipe Size
Elbows	90° Long Radius	½"-24"	¾"-24"	1"-12"	1"-8"	4"-24"	3"-12"
Elbows	90° Short Radius	1"-30"	1½"-30"				
Elbows	45° Long Radius	½"-30"*	¾"-30"*	1"-12"	1"-8"	4"-24"	3"-12"
Returns	180° Long Radius	½"-24"	1"-24"	1"-12"	3"-8"	4"-24"	3"-12"
Returns	180° Short Radius	1"-30"	1½"-30"				
Returns	180° Extra Long Radius	1"-2½"	1"-2½"				
Tees	Straight	⅜"-24"	¾"-24"	1"-12"	1"-8"		
Tees	Reducing Outlet	⅜"-24"	¾"-24"	⅜"-12"	1"-8"		
Reducers	Concentric & Eccentric	1x⅜-24x20	1x⅜-24x20		1x⅜-12x10		
Caps		1"-24"	1"-24"		1"-8"		
Stub Ends	Lap Joint	1"-24"	1"-24"				
Nipples	Shaped, 90° to Header	1¼"-12"	1¼"-12"				
Nipples	Shaped, 45° to Header	1¼"-12"	1¼"-12"				
Saddles		2"-24"**					
Laterals	Straight	1¼"-24"	1¼"-24"				
Laterals	Reducing-on-Run	1¼"-24"	1¼"-24"				
Crosses	Straight	¾"-24"	¾"-24"				
Rings	Welding	¾"-12"	¾"-12"				
Sleeves	Welding	2"-24"**					

SUPER Tube-Turn 45° long radius elbows, 90° long radius elbows, and 180° long radius returns available in both Standard weight and Extra Strong in sizes from 3" to 12".

Tube-Turn welding fittings and flanges conform to applicable ASA and ASTM Standards. For further details please refer to Tube Turns catalog and data book No. 111.

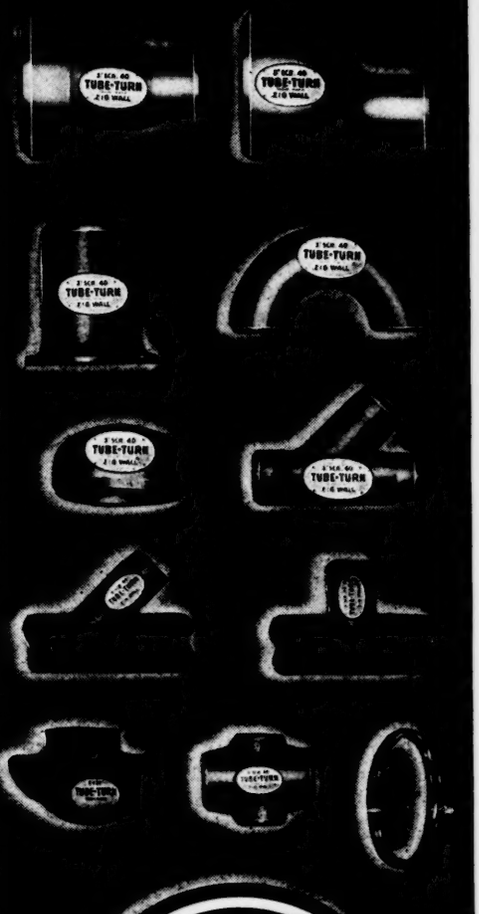
*30" size short radius.

**Since saddles and sleeves are used for external reinforcement only, they do not conform to iron pipe size thicknesses.

TUBE-TURN FORGED STEEL FLANGES—RANGE OF SIZES

	150 Lb.	300 Lb.	400 Lb.	600 Lb.	900 Lb.	1500 Lb.	2500 Lb.
Welding Neck	½"-24"	½"-24"	½"-24"†	½"-24"	½"-24"*	½"-24"	½"-24"
Slip-On	½"-24"	½"-24"	½"-24"†	½"-24"	½"-24"*	½"-24"	½"-24"
Lap Joint	½"-24"	½"-24"	½"-24"†	½"-24"	½"-24"*	½"-24"	½"-24"
Threaded	½"-24"	½"-24"	½"-24"†	½"-24"	½"-24"*	½"-24"	½"-24"
Blind	½"-24"	½"-24"	½"-24"†	½"-24"	½"-24"*	½"-24"	½"-24"
Socket Type	¼"-24"	¼"- 4"		¼"-3½"			
Reducing-threaded or slip-on	¾"-24"	¾"-24"	¾"-24"†	¾"-24"	¾"-24"*	¾"-24"	¾"-12"
Orifice—threaded		1"-24"	4"-12"	4"-12"	3"-12"	1"-12"	
Orifice—slip-on		1"-24"					
Orifice—welding neck		1"-24"	4"-12"	1"-12"	3"-12"	1"-12"	
Long Welding Neck	1"-24"	1"-24"	1"-10"	1"-10"	1"-10"	1"-10"	

†Dimensions on sizes thru 3½" same as for 600 lb. flanges.
*Dimensions on sizes thru 2½" same as for 1500 lb. flanges.



New Officers for Tubular Group

NEW YORK—At a meeting of the Tubular Exchanger Manufacturers Association at headquarters of the association, 366 Madison Avenue, New York 17, the following officers were elected: president, George A. Worn, The Lummus Company, New York; vice-president, William Bisch, The Griscom-Russell Company, New York; secretary-treasurer, W. J. Parker, 366 Madison Avenue, New York; H. W. Conarro, Struthers-Wells Corp., Warren, Pa., was elected a member of the executive committee, and W. C. Beekley, The Whitlock Mfg. Company of Hartford, Conn., ex-officio member of the executive committee.

Consolidated Edison Merger Rejected

NEW YORK—The New York Public Service Commission rejected June 6 a plan of Consolidated Edison Co. of New York to merge with its five subsidiaries, New York Steam Corp., Westchester Lighting Co., Yonkers Electric Light and Power Co., Brooklyn Edison Co., and New York and Queens Electric Light and Power Co.

In the case of New York Steam Corp. the Commission held that the functions of the company are dissimilar from the other companies in the Consolidated system and that the advantages of a merger—relatively small savings in operating cost—are more than offset by the interference with adequate rate and service regulations.

Priorities Aid to Small Manufacturers

WASHINGTON—WPB Priorities Regulation 27 offers assistance to manufacturers who need small amounts of materials for production. The new regulation is effective at once and ends December 31. It gives a rating of AA-4 to manufacturers who produce less than $50,000 worth of their own products per quarter, and permits orders now for delivery of steel, copper and aluminum after July 1, 1945, by use of a deferred CMP Allotment Symbol Z-3. This regulation does not apply to the following classifications:

1. Repairmen or persons engaged in service trades.
2. Jobbers, wholesalers and retailers.
3. Branches of companies unless production of the entire enterprise is within the $50,000 per quarter limit.
4. The rating cannot be used for purchase of capital equipment, maintenance, repair on operating supplies, or for paper and paper-board.
5. The rating cannot be used to purchase materials contrary to applicable WPB inventory restrictions.

Urges One-Story Industrial Plants

NEW YORK—Post-war plants should be constructed with an eye and ear toward the lessons learned in modern warfare, in the opinion of a New York industrial consultant. Francis Chilson, plant consultant for a number of industrial companies, urged this precaution in a speech prepared for the 1945 Eastern meeting of the American Pharmaceutical Manufacturers Association Committee on Production. The meeting was held "in print" because of war necessity.

"European bombing photographs clearly show that multi-story structures went down," Mr. Chilson reminded. "The one-story plant had to be hit almost in its entirety before it was out of business. That's a good lesson to remember even in peacetime. Physical breakdowns in the one-story plant can be isolated and restored with much greater facility than in the multi-story operation. Bottlenecks can be by-passed or liquidated more readily. Generally speaking, down time is in direct ratio to the number of floors in a factory."

Emergency Air Conditioning

RICHMOND, VA.—Windows on an Atlantic Coast Line train en route to Richmond from Washington were kicked out and broken with suitcases by servicemen desperate for air the night of June 17. The coaches were "air conditioned", with all windows sealed, and as passengers crowded into them at Washington, temperatures rose into the 100s, since no air conditioning equipment was functioning.

When the train pulled out of Washington, servicemen sweltering in at least two air-tight coaches, took suitcases and shoes and broke windows, getting fresh air into the overcrowded compartments.

It was learned that this has happened before, on similarly hot days.

Licensing of Patents Facilitated

WASHINGTON, D. C.—Commencing June 1, 1945, the U. S. Patent Office put in operation a new service to industry and inventors. The purpose of the service is to bring to the attention of the nation patented inventions under which the owners are willing to grant licenses on reasonable terms; it is hoped that such information will lead to greater employment opportunities in the reconversion period, as well as permit industry to become acquainted with what is being done in various fields.

To accomplish the purposes set out above, a Register of Patents Available for Licensing is now being established, and will be maintained in the U. S. Patent Office. Patents recorded on this register will be available to the public for inspection in Washington, D. C. Lists of such patents will be published in the Official Gazette of the Patent Office.

Myron J. Czarniecki

PITTSBURGH—Myron J. Czarniecki, vice-president in charge of sales for A. M. Byers Co., died suddenly on June 18 at his home near Pittsburgh. He was 53 years of age.

Myron J. Czarniecki

Mr. Czarniecki entered the employ of the Byers organization in 1913. He became manager of the company's Chicago sales office in 1919. He was transferred to New York in 1920 and managed that office until he was brought back to Pittsburgh in 1925 to become assistant general manager of sales.

He was advanced to general manager of sales in 1930 and his election to vice-president in charge of sales came in 1934.

Mr. Czarniecki was a member of the Pittsburgh Sales Executives Club, the American Iron & Steel Institute, American Petroleum Institute, American Supply & Machinery Manufacturers Association.

His widow, a son Lt. Myron J. Jr., of the USNR, and a daughter, E. Louise, student at Randolph Macon College for Women, survive.

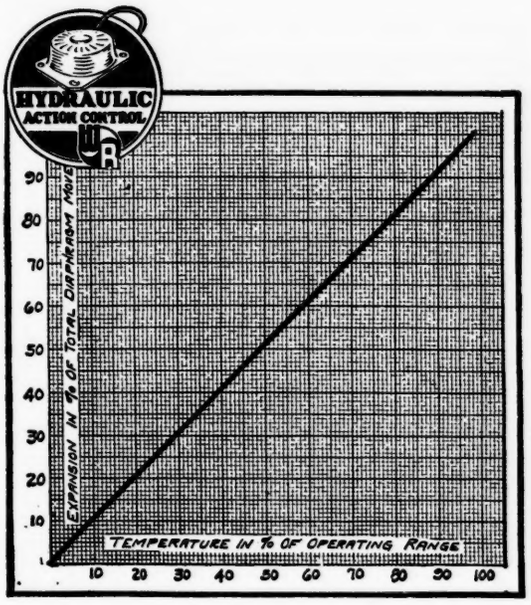
Roland R. Ware

KALAMAZOO—Roland R. Ware, 61, president and general manager of Clarage Fan Company, died at his home June 21. He had been critically ill for the past two months.

Mr. Ware had been actively identified with Clarage for over forty years.

DIAPHRAGM MOTION UNIFORM

★ PER DEGREE OF TEMPERATURE CHANGE


HYDRAULIC
ACTION CONTROL
EXPANSION IN % OF TOTAL DIAPHRAGM MOVE
TEMPERATURE IN % OF OPERATING RANGE
10 20 30 40 50 60 70 80 90 100

Notice, in the diagram at the left, how the expansion of the Hydraulic-Action diaphragm actually draws a straight line across the chart. This is because the force exerted by expansion or contraction under heat or cold is always *uniform*, and always predictable. That's another reason why White-Rodgers controls are easier to install and free of trouble.

8 EXCLUSIVE FEATURES OF WHITE-RODGERS HYDRAULIC-ACTION TEMPERATURE CONTROLS

1. May be mounted at any angle or position, above, below or on level with control point.

2. Hydraulic-Action principle incorporating solid-liquid-filled bulb and capillary provides expansion force comparable to that of a metal bar.

★ 3. Diaphragm motion uniform per degree of temperature change.

4. Power of solid-liquid charge permits unusually sturdy switch construction resulting in positive contact closure.

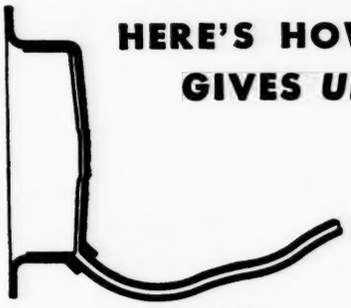
5. Heavier, longer-wearing parts are possible because of unlimited power.

6. Dials are evenly and accurately calibrated over their entire range because of straight-line expansion.

7. Controls with remote bulb and capillary are not sensitive to change in room temperature. Accuracy of control is not affected by temperature changes in surrounding area.

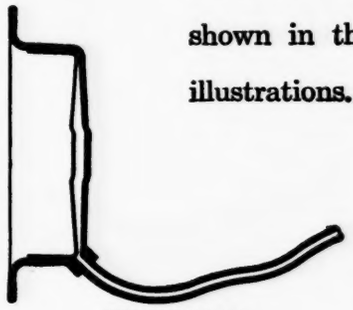
8. Not affected by atmospheric pressure. Works accurately at sea level or in the stratosphere without compensation or adjustment.

HERE'S HOW HYDRAULIC-ACTION GIVES *UNIFORM* EXPANSION



CONTRACTED

Above is a cross section of the diaphragm and part of the liquid-filled capillary. In this view the liquid has contracted, releasing the pressure on the diaphragm and causing the switch contacts to function.



EXPANDED

In this cross-sectional view, the liquid charge of the capillary has expanded with a rise in temperature. The positive force of this hydraulic action forces the diaphragm outward and causes the switch contacts to function.

The solid-liquid charge of Hydraulic-Action provides uniform expansion and *uniform* motion of the diaphragm, as shown in the accompanying illustrations.

Actual-size illustration of the White-Rodgers diaphragm body, the actuating element of every White-Rodgers temperature control. It is so designed as to exert full pressure at the point of contact with the switch mechanism.

WHITE-RODGERS ELECTRIC CO.

1207F CASS AVENUE ST. LOUIS 6, MISSOURI

Controls for Refrigeration • Heating • Air-Conditioning

NEWS OF EQUIPMENT AND MATERIALS

Adsco Water Heater

NAME—ADSCO type R water heater.
PURPOSE—Instantaneous water heater for commercial, industrial and in-

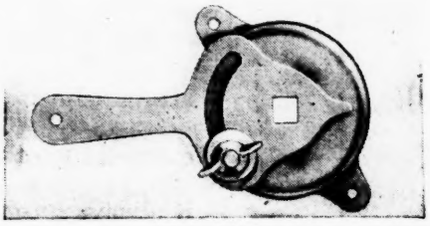
stitutional buildings. May also be used as a converter to heat water in conventional hot water heating system or in connection with radiant heating installations.
FEATURES—Compact, steel shelled 1¼ in. OD No. 16 BWG copper U-tube removable heating element, low friction loss type for use with gravity recirculation system, or where minimum friction loss in the water space is desirable. Steam flows through tubes. Generally smaller in diameter and longer than company's type E heater and offers price advantage for comparable capacities.
SIZES AND CAPACITIES—22 sizes, with capacities ranging from 158 to 8435 gallons per hour with 212F steam when heating water from 40F to 140F.
LITERATURE AVAILABLE—Bulletin 35-76B, giving dimensional and capacity data for a range of water temperatures and giving capacity and square feet of radiation for heater when used as converter.
MADE BY — *American District Steam Co., N. Tonawanda, N. Y.*

Fire Protection Device

NAME—Kidde pressure switch.
PURPOSE—Pressure switch for use with built-in carbon-dioxide fire extinguishing systems.
FEATURES—Device assists in isolating the fire by automatically cutting off electrical circuits in fans, blowers or other electrical equipment when the extinguishing system functions. Switch is connected by a bleed pipe from the main distribution line and is operated by the gas passing through the distributing piping to the discharge nozzles. The gas pressure actuates a plunger which trips the breaker arm of the switch, thus opening or closing the circuits desired. The device can be used for control of 2, 3, or 4 circuits. The switch is provided with a manual reset to restore circuits to their original position after operation due to fire.
MADE BY—*Walter Kidde & Co., Inc., 140 Cedar St., New York 6, N. Y.*

Damper Quadrant

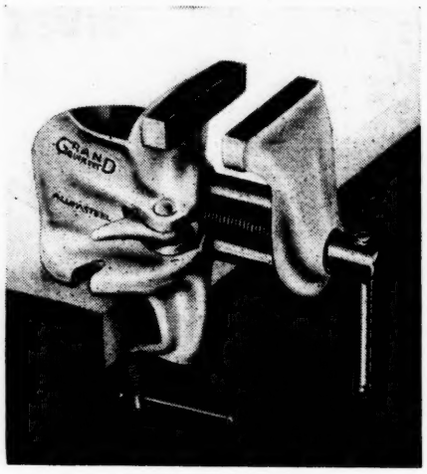
NAME—Damper quadrant.
PURPOSE — For regulating setting of dampers.
FEATURES—Comes in ¼ and ⅜ in. sizes, plated with rust-resisting cadmium. Advantages claimed are ease of installation and dependability.



MADE BY—*Western Air Devices, Inc., 1349 E. Vernon Ave., Los Angeles.*

Quick-acting Vise

NAME—Grand Speed Quickcet Vise.
PURPOSE—Running in or out the screw of this machinist's vise, for



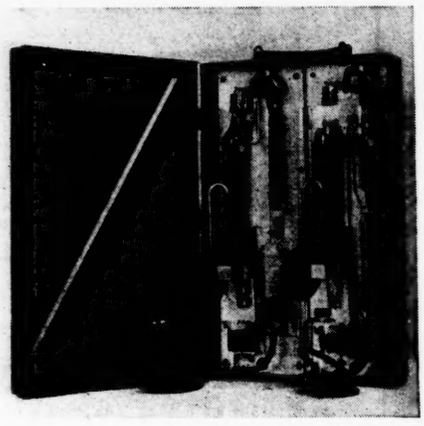
opening or closing, is eliminated.
FEATURES—The body of the free jaw slides swiftly on a ratchet screw and two precision guide rods. The jaw tightens with a turn of the handle.
MADE BY—*Grand Specialties Co., 3135 W. Grand Ave., Chicago 22, Ill.*

Non-Spatter Welding Film

NAME—Lincoln "Non-Spatter" Film.
PURPOSE—To minimize the adherence of welding spatter to metal and reduce cleaning time.
FEATURES—Liquid film can be sprayed or painted on metal to be welded. Welding can proceed whether film is wet or dry. Paint can be applied over film. Film washes off with water. After welding, spatter can be removed by wiping or brushing. Film is supplied in concentrated form in 5 gallon cans and is diluted with three parts of water before using.
MADE BY—*The Lincoln Electric Co., Cleveland, Ohio.*

Hays Gas Analyzer

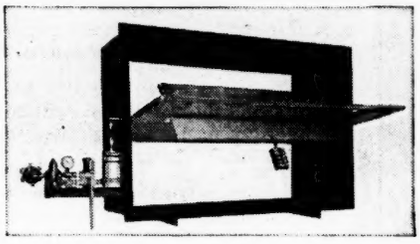
NAME—Hays series E gas analyzer.
PURPOSE—For testing purity of oxygen, carbon dioxide and nitrogen in range from 90 to 100%.
FEATURES—Device is similar to Orsat, but its technique and operation differs somewhat. Offered in two styles, a wall mounted model for permanent installation, and portable model with leather carrying handle. A junior



model, series E-J, is also available.
LITERATURE AVAILABLE—Pub. 45-743.
MADE BY—*The Hays Corp., Michigan City, Ind.*

Stackmaster

NAME—Stackmaster.
PURPOSE—Double damper smoke control for adjusting stack to varying weather conditions.
FEATURES—Installed with either electric, hydraulic, pneumatic control system so that it may be designed to meet practically all conditions where

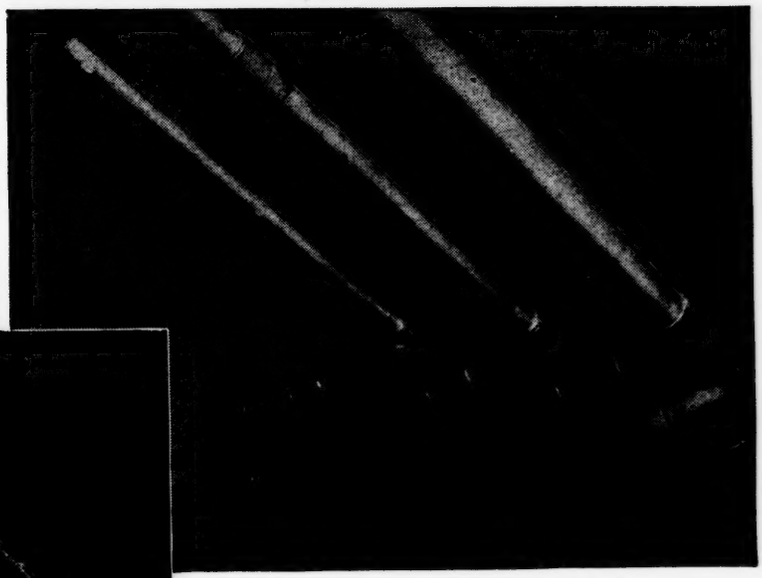


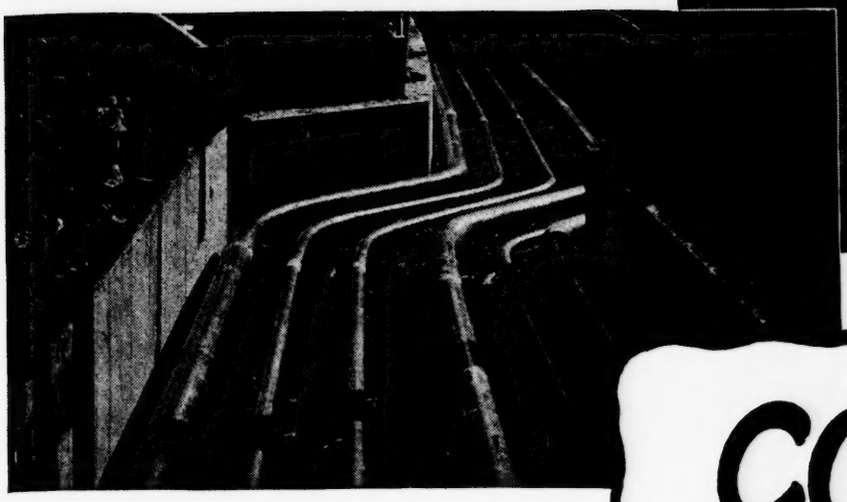
there are excess smoke and combustion losses.
SIZES AND CAPACITIES—Various sizes to accommodate wide range of stacks.
MADE BY—*Campbell Engineering Co., Appleton, Wis.*

Portable Recording Thermometer

NAME — Taylor portable recording thermometer.

The manufacturer, Taylor Instrument Companies, 31 Ames St., Rochester 1, N. Y., announces that this device, suspended from its line during the war, is again in production.





COPPER cures headaches!

WHEREVER water or heating lines must run—indoors, outdoors, in walls, floors, underground—copper tube can prevent or cure the kind of troubles that cause headaches. Copper is versatile because it is enduring. With no rusting to cause leaks, to discolor water or cut down the flow, Revere Copper Tube can be specified or installed with confidence.

Revere Copper Tube (99.9% pure copper) is seamless and is cold drawn with a gun-barrel finish inside. It is deoxidized and is free from flaws and blemishes. Joints are made with either soldered or compression fittings.

Designed for water supply, heating, air conditioning and other services in all types of buildings, this tube is stamped with the Revere name and type at regular intervals. Look for these identification marks—they insure full wall thickness and the close gauge tolerances so essential for tight sweated joints.

In making your plans you can specify or use such long-lived Revere materials as Copper Tube and Pipe; Red-Brass Pipe; Sheet Copper for tanks, ducts, pans and trays; Sheet Herculoy for tanks; Dryseal Copper Refrigeration Tube (dehydrated and sealed); copper oil burner, heat control and capillary tubes.

Revere materials are handled by Revere Distributors in all parts of the country. The Revere Technical Advisory Service, Architectural, is always ready to serve you. Call your Revere Distributor.

REVERE

COPPER AND BRASS INCORPORATED

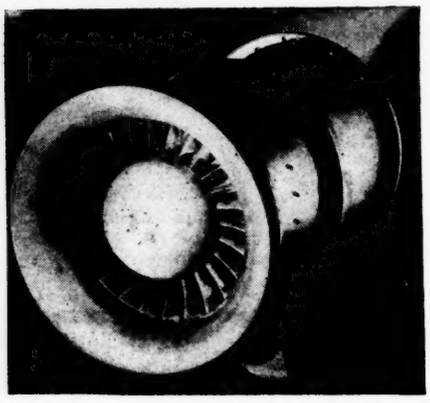
Founded by Paul Revere in 1801

Executive Offices: 230 Park Avenue, New York 17, N.Y.

Listen to the Human Adventure *on the Mutual Network every Wednesday evening, 10 to 10:30 p. m., EWT*

Axial-fan Blower

NAME—Axial-fan blower.
PURPOSE—Unit with high efficiency and with improved pressure and flow characteristics.
FEATURES—The 14 in. diam. blower illustrated delivers 8,000 cfm and 10 in. sp. at 3450 rpm. It is driven

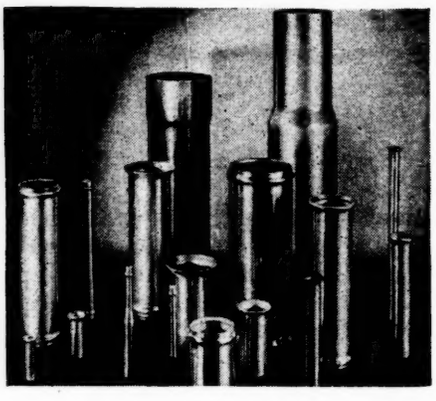


by an 8 in. 20 hp. motor. Complete unit weighs only 130 lb. Noise level claimed to be extremely low.

Company also producing a line of Axial-Flow compressors and fans, including a wide range of direct driven units with air pressures from ⅜ to 100 in. of water; also direct connected turbine driven units up to 100 lb per sq in and 100,000 cfm.
MADE BY—*Buffalo Turbine Corp., 2165 Bailey Ave., Buffalo 11, N. Y.*

Tube End Forming Machine

NAME—Vaill No. 7 tube end forming machine.
PURPOSE—For beading, flaring, flang-

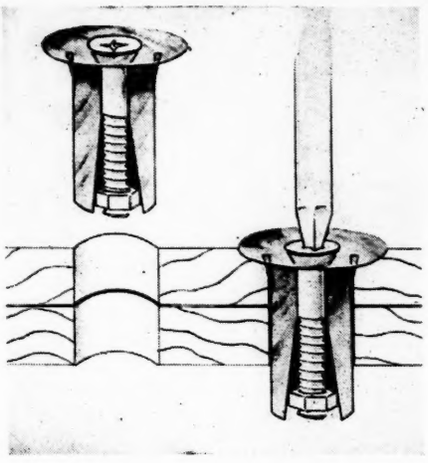


ing, expanding and reducing tubing in diameter on a production basis.
FEATURES — Machine is a versatile, compact and powerful double-action hydraulic press, automatically operated. Will handle tube ends from ¼ to 3 in. in diameter. Forming operations are accomplished by cold forging. Illustration shows type of work done by machine.
LITERATURE AVAILABLE — Eight-page bulletin.
MADE BY—*Vaill Engineering Co., 70 N. Elm Street, Waterbury 89, Conn.*

Blind Bolt Assembly

NAME—Des-Bolt.
PURPOSE—Used in the fabrication of laminate sections such as partitions; also on small assemblies such as radio equipment where one side is inaccessible for holding nut.
FEATURES—Composed of molded plastic expansion sleeve and any standard nut and bolt assembly of the correct size to match the sleeve. The sleeve is composed of three thin fingers with an inside taper. The head is a flange with a cored hole to receive standard countersink bolts. Three sharp ribs attach flange and sleeve and wedge into work to prevent turning of the sleeve.

To apply, the assembled unit is inserted into a drilled hole the size of the outside diameter of the sleeve, the unit tapped lightly and the bolt tightened. As the bolt is turned, the



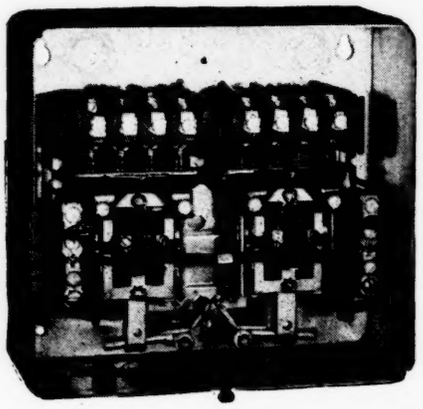
nut is drawn into the tapered prongs and forces them outward, drawing the work together.
SIZES—Range in present production from ¼ in. to ¾ in. diameter by ¼ in. to 3 in. in length. Special sizes may be obtained.
MADE BY—*Victory Manufacturing Co., 1105 So. Fairoaks Ave., So. Pasadena, Calif.*

Voice Booster

NAME — Talk-a-phone HP 16 X-tra power booster.
PURPOSE—A device to enable the regular intercommunication system to become a paging system.
FEATURES—The HP 16 can deliver a minimum of 16 watts "voice range" power, although where greater power levels are necessary, more than one booster can be used. The units are connected to the master station by only four wires that are furnished with the booster. It operates on 110 volts a-c, 60 cycles.
LITERATURE AVAILABLE — Booster and accessories described in an 8-page catalog.
MADE BY—*Talk-a-Phone Mfg. Co., 1512 S. Pulaski Rd., Chicago 23, Ill.*

Reversing Starter

NAME—An a-c magnetic reversing starter.
PURPOSE—For full voltage starting of squirrel-cage induction motors.
FEATURES—A new, semi-interference type mechanical interlock prevents the closing of one contactor while an arc is maintained in the other, thus



averting a short circuit through the arc. In addition, the interlock arm of the closing contactor assists the interlock arm of the opening contactor in reaching its fully open position. Interlock arms are case hardened and underside faces are buffed and polished to provide longer life. Other features of this starter include undervoltage protection when used with a push buttom station or other momentary pilot-circuit device; undervoltage release when used with selector or limit switches; and tamper-proof self-contained overload relays which allow the motor to operate up to its maximum safe temperature before tripping it off the line. Dust-tight and water-tight enclosures are furnished where conditions warrant.
MADE BY—*General Electric Company, Schenectady, N. Y.*

Goggle Cleaning Station

NAME—Sani-Spray Goggle Station.
PURPOSE—To provide cleaning fluid, applicator and cleansing tissue at convenient stations for cleaning and fog-proofing industrial goggles.
FEATURES—Station is a self-contained, heavy duty, steel, atomizer cabinet designed especially for applying Sani-Spray Goggle Cleaner. The cabinet holds a quart jar of fluid, a supply of tissue paper, and a receptacle for used tissue. A push button control releases a fine mist of Sani-Spray from an orifice on one side of the cabinet. Pressure is provided by connecting, through an adjustable control valve, to the plant air line. Cabinet attaches to wall at any convenient location in plant and is tamper-proof.
MADE BY—*Allen Optical Co., Buffalo 2, N. Y.*

Ducts for good weather with GALVANIZED

It's always good weather indoors, where there's a well-designed air-conditioning system. In many an air-conditioning installation the ducts that carry the "good weather" are made from Beth-Cu-Loy galvanized sheets.

These copper-bearing sheets, with their tight, uniform zinc-coating, are exceptionally ductile. They can be cut, formed on the brake, hammered and soldered readily.

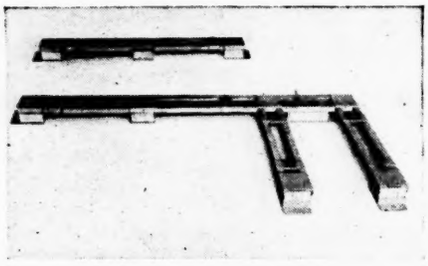
Copper-bearing steel of Beth-Cu-Loy composition—0.20 to 0.30 percent copper—is from two to three times more corrosion-resistant than ordinary steels or irons. With the galvanized coating, this gives ample protection in installations where corrosion is a factor.

Plan to use Beth-Cu-Loy galvanized sheets on vour next job where corrosion-resistance is needed. Their slight extra initial cost will be more than repaid in long and reliable service. Full information at the nearest Bethlehem district office—or write direct to Bethlehem Steel Company, Bethlehem, Pa.

★ ★ BETHLEHEM STEEL ★ ★

Fan Base

NAME—Twin rail fan base.
PURPOSE—Vibration control.
FEATURES—Base has adjustable fan and motor fastenings and interchangeable prefabricated parts. Fan and motor rails consist of structural twin angles which are rigidly held in parallel relation by means of



closely fitted outer caps and inner steel spacers. Caps are used to fasten the fan and motor housings to the angle rails. By unlocking a single nut each cap can be moved quickly into any desired position. Isolating units are spaced to provide uniform loading on the entire assembly. A special device fastens the isolators to the angle rails and to the floor plates. Vibration or sound cannot pass through the fully isolated bolt. A choice of cork, rubber or steel spring isolators is offered. The twin rails are constructed of standard structural shapes consisting of 1 x 1 in. angles for the smaller fans, increasing in size for the larger fans.
MADE BY—*The Korfund Co., Inc., 48-33 32nd Pl., Long Island City 1, N. Y.*

Ventilating Louver

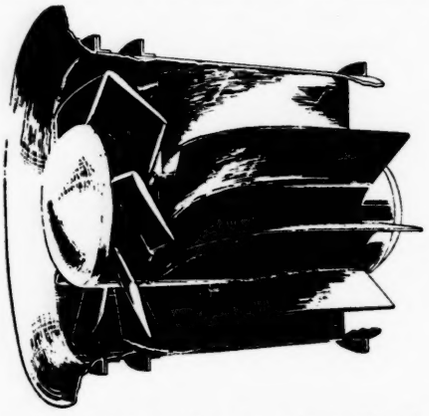
NAME—Airway louver.
PURPOSE—For mounting in the wall of attics or in the roof.
FEATURES—Adequate air circulation provided for the protection of insulation against mold and deterioration and for space ventilation. Made of 24 gauge steel with deep louvers so that rain and sleet cannot enter. Joints are spot welded. Fitted with a removable screen to keep out bugs and birds.
MADE BY—*Firecraft Corp., 3319 S. Wallace St., Chicago 16, Ill.*

Temperature Controls

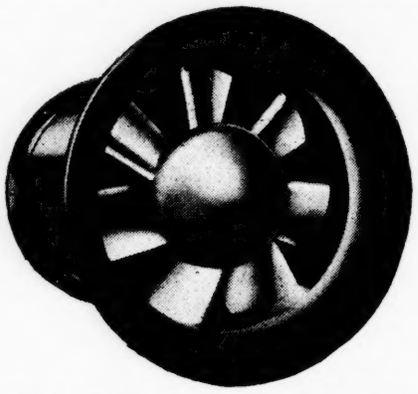
NAME—Cam-Stat.
PURPOSE—For control of temperature, pressure, humidity and mechanical displacement.
FEATURES — Double break contacts; applicable range from —100F to 600F; enclosed contacts; single pole single throw, single pole double throw or independent circuit double throw; resistant to vibration.
MADE BY — *Thermal Division, The Paul Henry Co., 2037 S. La Cienega Blvd., Los Angeles 34, Calif.*

Hartzell Vaneaxial Blower

NAME—Hartzell Vaneaxial blower.
PURPOSE—For axial-flow high pressure air movement.
FEATURES—Each blower is built into a duct section which is shipped as a unit. Manufacturer reports 87% total efficiency in standard code wind tunnel tests; said to operate economically against 8 in. water gauge. Noise factor claimed to be well below decibel rating of comparable equipment. Nose is shaped to avoid air turbulence, motor and outer shell are smooth and straight, and belt guards,



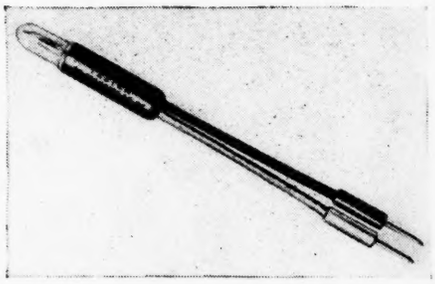
on belt-drive models, are streamlined. At each end is an angle iron ring with holes drilled so that it can be slipped into place and bolted to adjoining sections. For mounting at intake end of duct, blower is equipped with entrance bell as shown on the accompanying drawing cutaway view. In drawing, entrance of air is from left and guide vanes are behind the



wheel. Wheel is cased in aluminum alloy. Vanes are welded to both inner and outer shells and form rigid support for motor housing, motor and wheel. Inner and outer shells are of 7-gauge steel.
SIZES AND CAPACITIES — Available either in direct drive or belt drive models. Available in six fan sizes with ratings ranging from 3,000 to 59,00 cfm, depending on model and motor horsepower.
LITERATURE AVAILABLE—Bulletin 1601, covering the company's line of tube-axial and vaneaxial fans.
MADE BY—*Hartzell Propeller Fan Co., Piqua, Ohio.*

Circuit Tester

NAME—All-Purpose Circuit Tester.
PURPOSE — For locating blown fuses, trouble shooting in cords and appliances, testing radios, spark plugs, etc.
FEATURES—Tester is vest-pocket size and indicates voltages from 90 d-c and 60 a-c to 500 volts a-c or d-c.



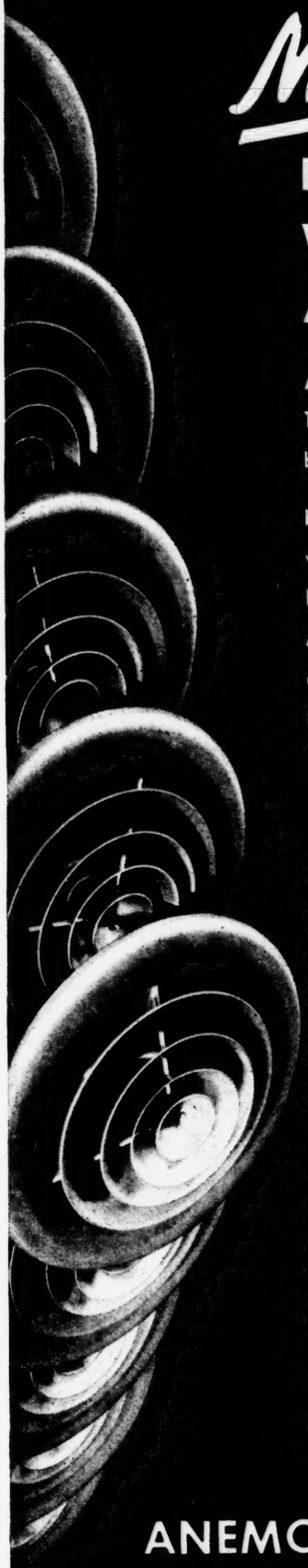
A neon lamp on the top glows with varying intensities indicating circuit conditions. The lamp lights on currents as low as one micro-ampere.
MADE BY—*Amerline, 1753 N. Honore St., Chicago 22, Ill.*

Welding Electrode

NAME—ACP Electrode.
PURPOSE—For welding in all positions and with a-c and d-c- reverse polarity.
FEATURES—A heavily coated electrode designed for high quality welds on work which is not easily positioned. Forms a light, porous slag, said to be removed from each pass by light brushing. Because of high tensile strength and ductility of welds made with ACP, the manufacturers claim it is especially suited for heavy plate fabrication, pressure piping and general structural steel work. ACP is adapted to vertical and overhead work on low and medium carbon steels as well as low alloy and cast steels.
SIZES—Available in 7 diameters from 5/16 inch to 3/32 inch.
MADE BY — *Westinghouse Electric Corp., Pittsburgh 30, Pa.*

Filter Cleaner

NAME—Turco process of filter cleaning.
PURPOSE — To provide a chemical means for cleaning all types of air filters.
FEATURES—Filter is removed and immersed in a tank of cold Turco Aktiv, 4 ounces to a gallon of water. Filter is then removed and is given a cold water hosing to flush away dirt and grease, followed by drying in a stream of compressed air. Filter is next dipped in an oil. Cleaning process is said to require but 13 minutes. No odor remains on filters.
MADE BY—*Turco Products, Inc., 6135 S. Central Ave., Los Angeles 1, Calif.*



More Anemostats Provide Draftless Air Distribution in War Production Plants than All Other Types of Ceiling Air Diffusers Combined . . .

The satisfaction of the users and specifying engineers is attested by a multitude of repeat orders.

Huge Anemostats handle the desired volume of air for heating in winter and cooling in summer, at duct speeds of over 30 miles per hour — yet there is no draft condition in the breathing zone. Then Anemostats serve Instrument Rooms where a temperature variation of not more than plus-minus ½° is permissible. Any conditions can be met with the Anemostat!
Consult us on special applications.

Partial List of Installations

Agfa Ansco Corporation
Allis Chalmers Mfg. Co.
Allison Engineering Corporation
Aluminum Co. of America
American Blower Co.
American Bosch Corp.
American Cyanamid Co.
Bausch & Lomb
Bell Aircraft Corp.
Bendix Aviation Corp.
Bethleham Steel Co.
Blaw Knox Co.
Boeing Aircraft Co.
Briggs Manufacturing Co.
Buick Motor Corp.
Carter Carburetor Co.
Cessna Aircraft Co.
Chain Belt Co.
Champion Spark Plug Co.
Chevrolet Aircraft Corp.
Chrysler Corp.
Columbia Steel Co.
Cramp Shipbuilding Co.
Crosley Corporation
Curtiss Wright Co.
Cutler Hammer Inc.
Defense Plant Corp.
Delco Appliance Div.
Douglas Aircraft Co.
E. I. duPont de Nemours
Eastern Aircraft Corp.
Eastman Kodak Co.
Fairchild Aircraft Co.
Ford Motor Co.
General Electric Co.
Goodyear Aircraft Corp.
Grumman Aircraft Eng. Corp.
International Business Machines Corp.
Johnson and Johnson
Jones & Laughlin Steel Corp.
Kaiser Shipbuilding Corp.
Kollsman Instrument Corp.
Glenn L. Martin Co.
Minneapolis-Honeywell Co.
Nash Kelvinator Co.
National Cash Register Co.
New York Shipbuilding Corp.
North American Aviation Inc.
Northern Pump Co.
Norton Company
Packard Motor Co.
Pullman Standard Co.
Republic Aviation Corp.
Ross Industries Corp.
Ryan-Aeronautical Co.
Sharp and Dohme Co.
Sperry Gyroscope Co.
Standard Oil Co.
Stewart Warner Corp.
U. S. Rubber Co.
Vega Airplane Co.
Warner and Swasey Co.
Westinghouse Elect. Mfg. Co.
Worthington Pump Co.

And more than thirteen thousand other installations

ANEMOSTAT

ANEMOSTAT CORPORATION of AMERICA

10 EAST 39th STREET, NEW YORK, N. Y.

"NO AIR-CONDITIONING SYSTEM IS BETTER THAN ITS AIR DISTRIBUTION"

Degree-Days for May, 1945

HEATING AND VENTILATING'S 18TH YEAR OF PUBLICATION OF MONTHLY DEGREE-DAY DATA

CITY	MAY			CUMULATIVE, SEPTEMBER 1 TO MAY 31			HEATING SEASON[1]
	1945	1944	NORMAL	1945	1944	NORMAL	NORMAL
Abilene, Texas	37	18	0	2484	2530	2061	2061
Albany, New York	360	112	183	6793	7122	6580	6580
Albuquerque, New Mexico	41	85	40	4303	4860	4298	4298
Alpena, Michigan	564	349	465	7661	7817	8127	8299*
Anaconda, Montana	531	444	517	7882	7729	8010	8357**
Asheville, North Carolina	188	62	71	3780	4214	4232	4232
Atlanta, Georgia	106	34	0	2846	2939	2890	2890
Atlantic City, New Jersey	209	139	220	4761	4954	5176	5176
Augusta, Georgia	36	12	0	2099	2271	2161	2161
Baker, Oregon	391	369	431	6607	6677	6950	7163
Baltimore, Maryland	128	25	22	4214	4445	4533	4533
Billings, Montana	408	220	316	6823	6366	7059	7119
Binghamton, New York	340	104	254	6547	6925	6808	6808
Birmingham, Alabama	74	43	0	2632	2916	2352	2352
Bismarck, North Dakota	480	200	338	8414	8019	9147	9192
Block Island, Rhode Island	372	241	378	5608	5767	5689	5788
Boise, Idaho	265	224	236	5643	5835	5552	5552
Boston, Massachusetts	313	121	245	5703	5986	6045	6045
Bozeman, Montana	513	373	471	7724	7638	8195	8521**
Buffalo, New York	447	130	335	6675	6904	6810	6822
Burlington, Vermont	405	169	273	7610	8041	7511	7514
Butte, Montana	525	465	502	8154	8320	7926	8272
Cairo, Illinois	125	58	0	3809	3961	3909	3909
Canton, New York	449	147	334	7911	8055	8020	8020
Charles City, Iowa	381	169	224	7315	7331	7588	7588
Charleston, South Carolina	11	4	0	1784	1874	1769	1769
Charlotte, North Carolina	90	19	0	3019	3125	3120	3120
Chattanooga, Tennessee	107	48	0	3380	3587	3118	3118
Cheyenne, Wyoming	453	393	446	7236	7345	7340	7466
Chicago, Illinois	331	136	242	5975	6381	5957	5957
Cincinnati, Ohio	196	58	0	4932	4927	4684	4684
Cleveland, Ohio	360	108	220	5929	5986	6155	6155
Columbia, Missouri	218	100	22	4934	5220	4922	4922
Columbia, South Carolina	59	13	0	2325	2474	2364	2364
Columbus, Ohio	241	49	87	5351	5357	5398	5398
Concord, New Hampshire	405	183	298	7241	7624	7299	7353
Concordia, Kansas	181	131	65	5014	5657	5315	5315
Dallas, Texas	32	18	0	2232	2436	2256	2256
Davenport, Iowa	289	131	118	5965	6185	6289	6289
Dayton, Ohio	282	79	81	5723	5771	5264	5264
Denver, Colorado	253	226	267	5509	5794	5874	5874
Des Moines, Iowa	291	139	118	6099	6406	6384	6384
Detroit, Michigan	397	144	226	6295	6561	6490	6490
Devils Lake, North Dakota	592	267	424	9183	9053	9874	9970
Dodge City, Kansas	191	128	47	4973	5541	5035	5035
Dubuque, Iowa	331	148	149	6522	6698	6790	6790
Duluth, Minnesota	606	457	521	8849	9015	9267	9483
Eastport, Maine	581	438	543	7413	7856	7941	8520**
Elkins, West Virginia	319	59	177	5737	5780	5697	5697
El Paso, Texas	1	10	0	2546	2812	2428	2428
Ely, Nevada	496	432	—	7760	7771	—	—
Erie, Pennsylvania	399	134	257	5944	6351	6273	6273
Escanaba, Michigan	584	357	490	8202	8093	8608	8771*
Evansville, Indiana	190	83	0	4621	4776	4244	4244
Fort Smith, Arkansas	81	43	0	3075	3247	3147	3147
Fort Wayne, Indiana	390	128	130	6439	6575	5925	5925
Fort Worth, Texas	32	16	0	2257	2385	2148	2148
Fresno, California	24	26	0	2690	2564	2334	2334
Galveston, Texas	2	2	0	976	1163	1016	1016
Grand Junction, Colorado	86	128	118	5000	5439	5548	5548
Grand Rapids, Michigan	382	175	174	6234	6573	6535	6535
Green Bay, Wisconsin	448	226	322	7471	7592	7825	7825
Greensboro, North Carolina	134	29	0	3773	4055	3529	3529
Greenville, South Carolina	90	23	0	3009	3168	3380	3380
Harrisburg, Pennsylvania	202	30	90	5215	5487	5375	5375
Hartford, Connecticut	292	86	202	6114	6284	6036	6036
Hatteras, North Carolina	48	3	0	2662	2724	2571	2571
Havre, Montana	405	221	369	8012	7125	8556	8700
Helena, Montana	431	359	402	7777	7702	7663	7898
Houston, Texas	11	4	0	1163	1304	1157	1157
Huron, South Dakota	397	178	267	7436	7723	8004	8004
Indianapolis, Indiana	235	82	59	5230	5383	5298	5298
Jackson, Miss.	40	—	2079	—	—	—	—
Kansas City, Missouri	211	114	6	4727	5218	4956	4956
Kewanee, Illinois	269	127	133	5785	6535	6129	6139
Knoxville, Tennessee	137	42	0	3592	3709	3670	3670
La Crosse, Wisconsin	407	161	183	7163	7366	7322	7322
Lander, Wyoming	368	348	428	8494	8373	7812	7947

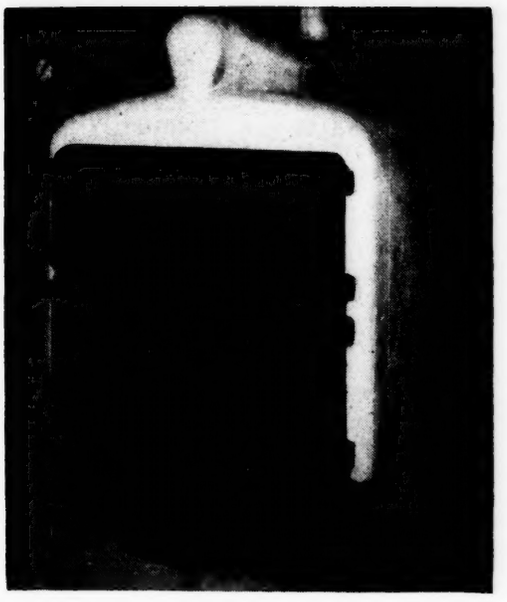
[1]Figures in this column are normal totals for a complete heating season, September to June, incl.

Figures in this table, with nine exceptions, based on local weather bureau reports. Exceptions are Utica, Lewiston, Kewanee, Sioux City, and Jackson, figures for which are furnished through the courtesy of Coke Sales Department, Central New York Power Corp., Utica, N. Y.; Norman E. Ross, Bursar, Bates College, Lewiston, Me.; J. M. Hartman, Engineering Department, Kewanee Boiler Corp., Kewanee, Ill., Alfred R. Wagstaff, Engineer, Sioux City Foundry and Boiler Co., Sioux City, Iowa, and H. M. Ludlow, Box 1368, Jackson, Miss., respectively; Anaconda, Bozeman, Butte and Livingston, Mont., through the courtesy of the Montana Power Company.

(a) Data not available.

[Table concluded on page 110]

Boiler Plant . . . FOR THE POST-WAR COMMERCIAL BUILDING



Architect, Fred VonBeren specified an H. B. SMITH 11 section No. 34 Mills cast-iron water tube boiler for the New Haven Liggett store. This boiler is now hand-fired, but if advisable, it can easily be converted after the war to oil or stoker, without any loss in efficiency. Buckingham & Routhe Co. of New Haven were the heating contractors.

THE best in war time commercial construction is well exemplified by the new Liggett Drug Co. store in New Haven, Conn.

This attractive building, while erected in 1944 under W.P.B. restrictions, is heated by equipment well up to pre-war standards, and may very well be taken for a model for engineers planning installations of this type. It is our prediction that as far as actual heat generation is concerned post war boiler plants will closely resemble the best of war time installations. It is, therefore, to jobs such as this that the architect, engineer or contractor should turn for actual performance data on which to base his specifications.

The thousands of large H. B. SMITH cast-iron boilers installed in public and commercial buildings throughout the country are, by their daily operation, setting the standard for post war boiler plants. Specifiers and installers who will be judged by the equipment they recommend will do well to profit by this experience and specify a known quantity in boiler performance . . . H.B.SMITH.

H.B. Smith
CAST-IRON BOILERS

THE H. B. SMITH COMPANY, INCORPORATED • WESTFIELD, MASSACHUSETTS

Branch Offices and Sales Representatives in Principal Cities.

Degree-Days for May, 1945 (Concluded)

HEATING AND VENTILATING'S 18TH YEAR OF PUBLICATION OF MONTHLY DEGREE-DAY DATA

CITY	MAY			CUMULATIVE, SEPTEMBER 1 TO MAY 31			HEATING SEASON[1]
	1945	1944	NORMAL	1945	1944	NORMAL	NORMAL
Lansing, Michigan	455	192	229	6882	7195	7048	7048
Lewiston, Maine	425	247	344	7483	8060	7662	7707
Lincoln, Nebraska	266	152	99	5534	6120	5999	5999
Little Rock, Arkansas	76	43	0	3046	3138	2811	2811
Livingston, Montana	511	353	405	7132	6819	7043	7205
Los Angeles, California	110	98	90	1512	1407	1504	1504
Louisville, Kentucky	171	59	0	4342	4376	4180	4180
Lynchburg, Virginia	162	24	0	4220	3955	3980	3980
Macon, Georgia	41	21	0	2153	2384	2201	2201
Madison, Wisconsin	380	171	236	7017	7244	7429	7429
Marquette, Michigan	649	387	496	7973	8111	8464	8693*
Memphis, Tennessee	94	48	0	3212	3252	2950	2950
Meridian, Mississippi	54	28	0	2245	2385	2160	2160
Milwaukee, Wisconsin	461	261	350	6892	7254	7206	7245
Minneapolis, Minnesota	403	193	236	7569	7617	7850	7850
Modena, Utah	340	356	350	6405	6690	6520	6562
Montgomery, Alabama	32	25	0	1835	2066	1884	1884
Nantucket, Massachusetts	344	244	384	5478	5730	5834	5957
Nashville, Tennessee	130	54	0	3678	3720	3507	3507
New Haven, Connecticut	313	138	223	5904	6111	5895	5895
New Orleans, Louisiana	2	2	0	987	1234	1024	1024
New York, New York	204	93	155	4952	5364	5347	5347
†Nome, Alaska	1386	1461	1443	11340	11545	12085	14580**
Norfolk, Virginia	73	6	0	3234	3426	3350	3350
North Head, Washington	376	398	422	4361	4314	4693	5452**
North Platte, Nebraska	290	153	199	5970	6408	6366	6366
Oakland, California	263	218	205	2974	2868	2870	3143**
Oklahoma City, Oklahoma	97	55	0	3443	3667	3613	3613
Omaha, Nebraska	266	148	84	5914	6386	6131	6131
Oswego, New York	475	220	357	6772	7134	7025	7088
Parkersburg, West Virginia	211	36	53	4964	5041	4775	4775
Peoria, Illinois	312	131	121	5985	6268	6109	6109
Philadelphia, Pennsylvania	165	41	68	4578	4842	4855	4855
Phoenix, Arizona	0	0	0	1555	1519	1405	1405
Pittsburgh, Pennsylvania	235	38	78	5146	5368	5235	5235
Pocatello, Idaho	311	304	332	6805	6993	6595	6655
Portland, Maine	480	310	366	7375	7727	7137	7218
Portland, Oregon	180	208	245	3984	3983	4379	4469
Providence, Rhode Island	250	93	251	5400	5783	6015	6015
Pueblo, Colorado	178	183	186	5567	5997	5514	5514
Raleigh, North Carolina	98	17	0	3253	3440	3234	3234
Rapid City, South Dakota	425	249	344	7079	7216	7088	7118
Reading, Pennsylvania	197	38	96	5068	5305	5389	5389
Red Bluff, California	77	—	—	2673	—	—	—
Reno, Nevada	359	310	366	5873	5951	5802	5892
Richmond, Virginia	110	14	0	3702	3931	3695	3695
Rochester, New York	434	135	260	6851	7062	6732	6732
Roseburg, Oregon	204	262	267	3992	4165	4314	4428
Roswell, New Mexico	26	38	0	3308	3644	3484	3484
Sacramento, California	110	73	53	2689	2597	2653	2653
St. Joseph, Missouri	227	126	16	5086	5582	5161	5161
St. Louis, Missouri	191	94	0	4599	4717	4585	4585
Salt Lake City, Utah	202	186	236	5342	6126	5555	5555
San Antonio, Texas	6	12	0	1549	1683	1202	1202
San Diego, California	76	76	115	1492	1360	1639	1645
Sandusky, Ohio	349	115	183	5900	6048	6208	6208
San Francisco, California	297	255	264	2627	2454	2681	3264**
Sault Ste. Marie, Michigan	626	346	502	8759	8742	8950	9285**
Savannah, Georgia	15	3	0	1480	1531	1490	1490
Scranton, Pennsylvania	290	69	171	6121	6329	6129	6129
Seattle, Washington	203	262	316	4045	4101	4695	4934**
Sheridan, Wyoming	399	279	403	7264	7185	7888	8008
Shreveport, Louisiana	30	19	0	2097	2243	1938	1938
Sioux City, Iowa	344	161	164	6668	7010	6898	6898
Spokane, Washington	250	262	285	6002	6155	6274	6355
Springfield, Illinois	220	105	56	5657	5458	5373	5373
Springfield, Missouri	234	97	12	4640	4839	4428	4428
Syracuse, New York	391	129	267	6748	7137	6881	6893
Tacoma, Washington	244	304	332	4456	4557	4883	5181**
Terre Haute, Indiana	212	88	0	5025	5218	4872	4872
Toledo, Ohio	394	131	180	6485	6611	6077	6077
Topeka, Kansas	208	116	34	4717	5183	4969	4969
Trenton, New Jersey	182	54	81	4990	5327	4933	4933
Utica, New York	382	140	253	7170	7574	6796	6796
Valentine, Nebraska	367	199	273	6970	7270	7039	7039
Walla Walla, Washington	138	158	171	4636	4993	4808	4808
Washington, D. C.	149	15	25	4257	4456	4626	4626
Wichita, Kansas	190	89	0	4502	4784	4673	4673
Williston, North Dakota	507	229	362	8488	8050	9269	9323
Winnemucca, Nevada	299	281	324	6214	6336	6274	6427**
Yakima, Washington	144	171	186	5105	5385	5599	5599

†Nome data are for April.
(a) Data not available.

*Includes August.
**Includes July and August.

[1]Figures in this column are normal totals for a complete heating season, September to June, incl.

How Jim got caught with his Air Filtering costs down

It all grew out of one of those bets.

Jim, the general manager, didn't believe that the suggestion sent in by Mike (the maintenance man) would result in efficient, low-cost air filtering—but it did.

So Mike won the War Bond for his suggestion, and he won the side bet from Jim.

The contractor started it

You see, Mike had read about DUST-STOP* Air Filters—had read about them in this publication, in fact. And the contractor told him that DUST-STOPS and the complete, ready-to-assemble steel cell frames could be adapted to virtually any heating or air conditioning system.

The president saw the possibilities

Knowing that there must be good reasons for the widespread preference for DUST-STOP Air Filters, the president did some investigating of his own.

He found that DUST-STOPS are constructed of packs of glass fibers (Fiberglas*) coated with an adhesive, faced with metal grilles and bound on the edges with a fiberboard frame.

He also learned that the Fiberglas fibers, packed to proper density, form an exceptionally effective medium for air filtration. Being glass, they are inorganic, chemically stable, resistant to heat, corrosive vapors and most acids, and, being glass, they do not absorb the nonodorous, nonevaporating adhesive with which they are coated. Each impinged particle of dust is quickly soaked, acting as a wick to carry adhesive to other particles. Thus, the adhesive remains effective until the filter is so heavily loaded with dust that resistance to air flow calls for replacement.

Mike proves it

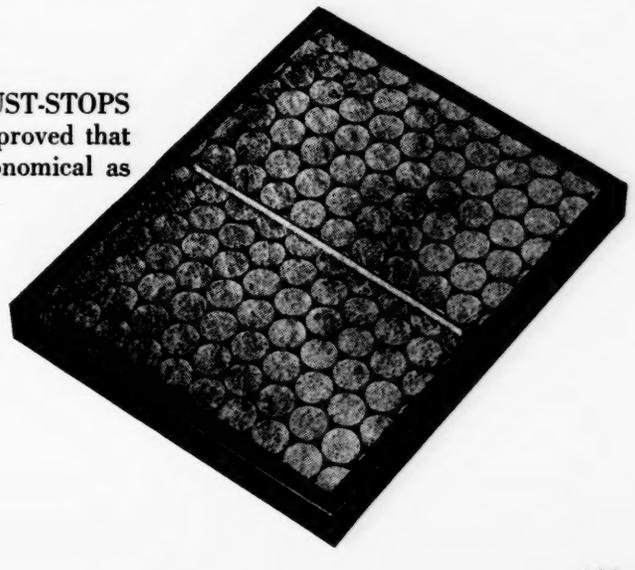
After the bank of the DUST-STOPS had been installed, Mike proved that maintenance, too, was economical as was the original installation. Replacement, which required no special tools or talents, could be accomplished, at low cost, with a minimum of manhours.

Then Jim realized that his air filtering costs were down. And, although he had lost the bet, the company, and

everyone in it, had won.

The use of DUST-STOP Air Filters, is a suggestion well worth considering. If you do not have complete information on DUST-STOP Air Filters, or typical installation details, see Sweet's Files or write: *Owens-Corning Fiberglas Corp., 1912 Nicholas Building, Toledo 1, Ohio.*

In Canada, Fiberglas Canada Ltd., Oshawa, Ontario.



DUSTOP AIR FILTERS

REG. U.S. PAT. OFF.

—a FIBERGLAS product

. . . Since the Last Issue

The appointments of **C. F. Cushing** as distribution manager, and of **James N. Crawford** as sales manager of the Gas Heating Division, **Bryant Heater Company**, Cleveland, were announced recently.

Mr. Crawford is a native of Cleveland and a graduate of Case School of Applied Science. He holds a BS degree in mechanical engineering. A member of the staff of the American Gas Association Testing Laboratory following his graduation from Case, Mr. Crawford has been associated with the Bryant Heater Company for the past 12 years.

James N. Crawford

C. F. Cushing

Mr. Cushing was born in Towson, Md., and attended The Johns Hopkins University, from which he was graduated with honors in mechanical engineering. He is active in ASHVE, the Advertising Club and the Sales Executives Club of Cleveland. Formerly associated with the Frigidaire Corporation, Mr. Cushing has been a member of the Bryant Heater Company staff since 1935.

Crane Co., Chicago, has announced the following changes in its sales and branch house division, effective June 16: **Carter T. Pollock**, formerly manager of the Chicago branch, is appointed manager of the central district with headquarters in Chicago; **W. A. Burbine**, formerly manager of the company's Cleveland branch, is made manager of the Chicago branch; **A. N. Rosborough**, formerly manager of the Toledo branch, is appointed manager of the branch in Cleveland; **W. D. LaRue**, Manager of the Muncie, Ind., branch, is promoted to the managership of the Toledo branch; and **R. C. Danielson**, formerly manager of the plumbing department at the Indianapolis branch, is made manager of the Muncie branch, replacing Mr. LaRue.

WPB approval, just received, authorizes new building and plant facilities of **Marlo Coil Company**, St. Louis, adding approximately 14,000 sq ft to the present 24,000 sq ft plant floor area. Construction has been started and when completed, the rearranged plant will provide augmented production capacity to meet the rapidly expanding demands for the company's line of heat transfer equipment. Part of the space is allocated to an increased production of evaporative coolers for diesel engines, transformer, cutting and quenching oils. Improved production facilities for air conditioning, industrial and commercial refrigeration equipment are to be provided.

The board of directors of the **United States Radiator Corp.**, Detroit, Mich., has reelected **L. Gillespie Erskine** as chairman of the board, and **James F. McIntire** as president. **Carroll M. Baumgardner** was made vice-president in charge of sales.

H. A. Thrush & Co., Peru, Ind., has appointed a direct factory representative, **Arthur J. Duemler**, for the St. Louis area.

A Lionel Lawrence, treasurer and director of **The H. B. Smith Co., Inc.**, Westfield, Mass., has been elected to membership in the **Controllers Institute of America.** The Institute is a technical and professional organization of controllers devoted to improvement of controllership procedure.

A new building for the **General Electric Company's** Research Laboratory in Schenectady, N. Y., which will afford 50% more space than present facilities provide, will be erected at a cost of $8 million, it was announced June 1. Construction will begin as soon as WPB approval can be obtained. The building will be air conditioned throughout.

The entire Milcor operation at Canton, Ohio, has moved to Cleveland. In that city Milcor manufacturing and sales will be co-ordinated with those of The J. M. & L. A. Osborn Co., which was recently purchased by the **Milcor Steel Company.** The revised name of the company is **The J. M. & L. A. Osborn Co., Division of Milcor Steel Company**, 1541 East 38th Street, Cleveland 14, Ohio.

Detroit Lubricator Co., Detroit, announces the appointments, effective May 1, of **E. J. Doucet**, general sales manager, to vice-president and general manager of sales, with headquarters at Detroit; and **K. B. Thorndike**, manager, Western regional office, to vice-president, Western regional office, with headquarters in Chicago.

American Engineering Company, Philadelphia, has appointed three additional sales agents: **Milton G. Brown**, 1847 East 28th St., Minneapolis 7, Minn., will represent the Taylor multiple retort and AE perfect spread stokers in Minneapolis, North Dakota and South Dakota, and the AE perfect spread stoker in the northwestern section of Wisconsin; **J. J. O'Shea**, 305 Techwood Drive, N. W., Atlanta, Ga., will represent both stokers in Alabama, Florida, Georgia and South Carolina; and **Thomas C. Messplay**, 5916 McGee St., Kansas City, Mo., will represent both stokers in Kansas, Oklahoma and western Missouri.

Carl B. McLaughlin will head up the recently established Engineering Service Division of **Tube Turns, Inc.**, Louisville, Ky. The division is rapidly developing new applications for Tube-Turn welding fittings.

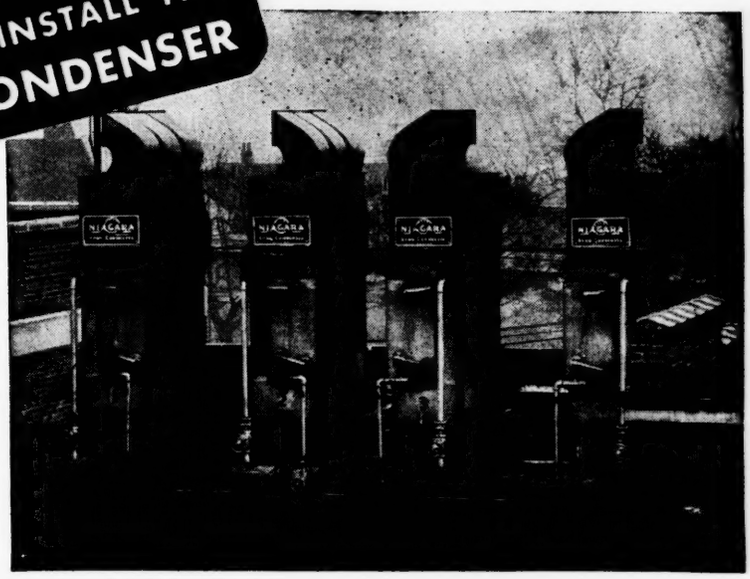
McLaughlin formerly was associated with Tube Turns' Pittsburgh office. A native of Jacksonville, Ill., he graduated from the University of Illinois in 1931 and was a metallurgist-engineer with the U. S. Steel Corp. before joining Tube Turns in 1943.

Carl B. McLaughlin

Stockholders of the **Eureka Vacuum Cleaner Company**, Detroit, and of the **Williams Oil-O-Matic Heating Corp.**, Bloomington, Ill., voted approval May 28 to a plan of merger of Williams into the Eureka company. Consummation of the acquisition of the Williams company by Eureka merge both of the manufacturing concerns into a single corporation which will operate as two divisions of the Eureka Vacuum Cleaner company. **H. W. Burritt**, who came to Eureka in 1939 as president, will continue with the newly enlarged company in the same capacity. **George T. Stevens** will continue as a vice-president and will become manager of the Eureka division. **William A. Matheson**, who has been president of Williams, will become a vice-president of Eureka and manager in charge of the Williams division.

PATENTED

YOUR OWN REFRIGERATION PLANT WILL GIVE MORE PRODUCTION WHEN YOU INSTALL THE NIAGARA Duo Pass AERO CONDENSER



● Reduced compressor head pressure increases your refrigeration capacity and the NIAGARA DUO-PASS AERO CONDENSER provides a sure method of constant operation at lower head pressure. Because, by the evaporative cooling principle, Niagara Duo-Pass Aero Condenser removes 1000 BTU per pound of water evaporated, you save cooling water costs amounting to thousands of dollars.

These gains are permanent because the patented NIAGARA "Duo-Pass" feature lowers the condensing temperatures to the point where no scale or precipitate can be deposited on the condenser tubes to reduce its capacity.

Get Bulletins 91 & 93 for full information.

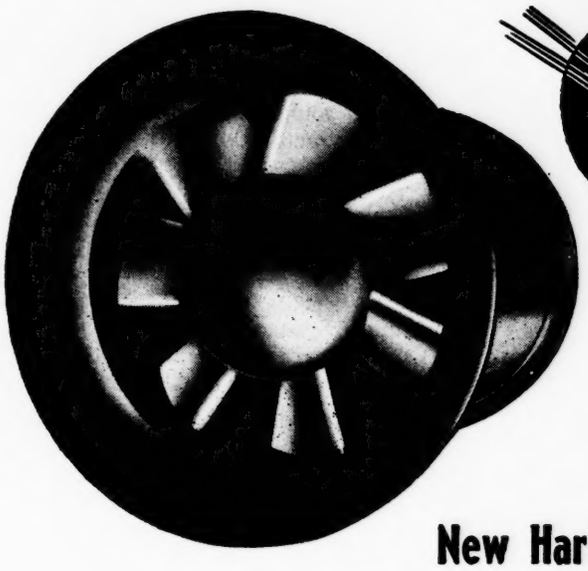
NIAGARA BLOWER COMPANY

Over 30 Years of Service in Industrial Air Engineering

Dept. HV-75, 6 E. 45th St. NEW YORK 17, N.Y.

Field Engineering Offices in Principal Cities

INDUSTRIAL COOLING HEATING • DRYING **NIAGARA** HUMIDIFYING • AIR ENGINEERING EQUPT.



"It Can't Be Done" . . . but here it is!

87% Efficient Against High Pressure and it's QUIET

The New Hartzell Vaneaxial Blower

A new high mark of efficiency in moving air *against 8" water gauge and more* is established by this great new blower. It embodies the experience of the originators of propeller-type air movement and three years of intensive research. Revolutionary design and precision production cut power cost to the bone, and insure long life. That's true economy, because operation cost and length of trouble-free life are by far the largest factors in blower cost. What's more, it's really quiet. It saves space. It installs easily, economically. It will give you results and save you money. WRITE FOR BULLETIN 1601!

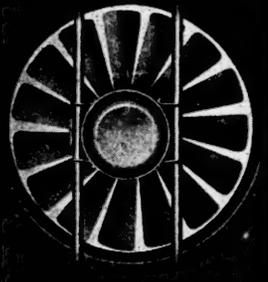
There is a precision-built Hartzell fan or blower for every air-moving need against zero pressure to 16" water gauge. Direct-Drive, Belt-Drive, Pulley-Drive, Extension-Shaft, Slow Tip-Speed and other specialized models. Experienced, nearby field engineering to insure proper installation, often the key to success.

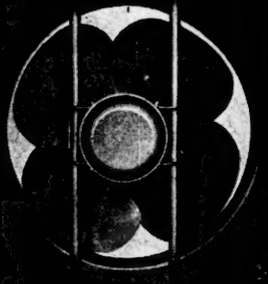
Hartzell PROPELLER FAN CO. PIQUA

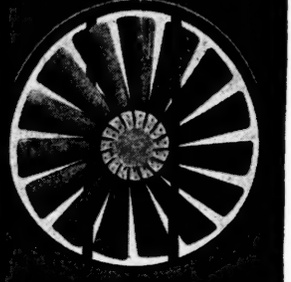
FOR FAST, QUIET AIR MOVEMENT INSTALL

Peerless Electric

PROPELLER FANS



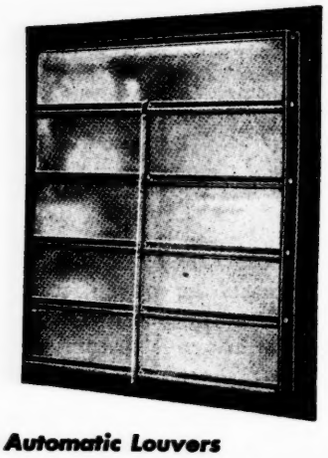




NO matter what your need for quiet, variable speed, attractively designed fans, you'll find the answer in a Peerless Electric design.

A combination of specially engineered capacitor motors and perfectly balanced extra wide blades produces extremely quiet operation. Motors are totally enclosed and permit installation in either a vertical or horizontal position.

These fans are supplied in single-speed, two-speed or three-speed operation and finished in gray. Recommended for stores, restaurants, hotels, offices and similar installations where quietness of operation and attractive appearance are prime requisites. Write for descriptive folders.



Automatic Louvers

Peerless Electric automatic louvers are designed especially for use with propeller fans. When the fan starts, the air stream instantly opens the louvers, which close by gravity when the fan stops. Completely weather-stripped around the inner edge of the frame. Built of high grade aluminum. Sizes from 10 to 48 inches.

For production achievement

THE Peerless Electric COMPANY

WARREN, OHIO

Established 1893

Surface Combustion Corp., with plants at Toledo and Columbus, Ohio, was host at an all-day meeting recently in Toledo for its field representatives from all parts of the country.

Principal topics of discussion were reallocation of manpower in light of changed conditions since V-E day, and the establishment of home-planning bureaus making available, to home owners and home planners, helpful and authentic information on latest principles and equipment for enhancing home conveniences and comfort.

A feature of the plan is a book especially written for G. I. Joe to help him with his plans for financing, planning and building his own home upon his return to civil life. Also included in the plan is a series of house designs by famous architects.

Among the 11 speakers on the program were **Frank Adams**, president and general manager, C. B. Phillips, vice-president and general sales manager, **W. J. Grover**, marketing director.

E. C. Alft has been designated as district manager for York-Heat Division of **York-Shipley, Inc.**, throughout the mid-western states. Following an extensive sales management career in the major household appliance field, Mr. Alft has been identified with the oil burner industry for the past fifteen years.

The division produces a line of oil burners, boiler-burner units, low and high pressure steam generators.

E. C. Alft

Young Radiator Co. announces the appointment of **J. A. Rumpsa** as director of purchases. Mr. Rumpsa comes to Young Radiator Co. with a wide background of practical experience in the field of purchasing. He completed an academic course at DePaul, Chicago, and became assistant purchasing agent for the Illinois Malleable Iron Co., Chicago. From the Illinois Malleable Iron Co. he moved to California to go into business for himself. In 1929 he joined the purchasing department of the Caterpillar Tractor Co.

Lloyd B. Smith, son of the late L. E. Smith, for many years chairman of the board of the **A. O. Smith Corporation**, was elected vice-president and member of the board at a directors meeting May 1. **Morris J. Vollmer**, former assistant to the president, was named assistant secretary and assistant treasurer, and **A. von Wening**, vice-president and controller, was elected to the board.

Fred L. Williams of Hartford has been added to the direct factory field organization of **H. A. Thrush & Co.** Mr. Williams will cover most of the state of Connecticut, western Massachusetts and the state of Vermont.

Lloyd W. Hemingway has been added to the engineering development staff of the Whiting Stoker Company, assigned to **Whiting Stoker Sales Co.**, Chicago, Ill., makers of household, industrial and commercial stokers.

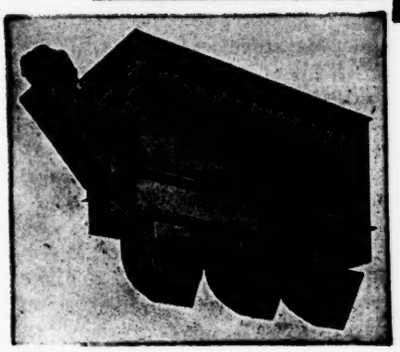
Mr. Hemingway received his engineering training at the Armour Institute of Technology and then joined the engineering staff of the Whiting Corporation, Harvey, Ill. He has had 16 years' experience in the stoker field, with duties ranging from construction supervision through sales, estimates and design engineering. His present duties will consist of research in and development of Whiting's line of stokers.

Lloyd W. Hemingway

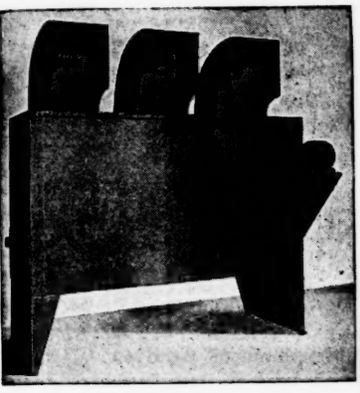
Available for Prompt Delivery—

THE AIRTHERM CENTRIFUGAL FAN TYPE, STEAM UNIT HEATER

(Vertical, Horizontal, or Floor Type Models)



Ceiling mounted, inverted type.



Floor mounted.

The Airtherm centrifugal, fan type, steam unit heater is a highly efficient heater for either vertical or horizontal suspension and is available to you for delivery during the present heating season.

This high velocity unit insures uniform temperature distribution and maximum heat flow effecting savings in both fuel and maintenance cost. Capacities range from 200,000 to 825,000 B.T.U.

Send us your specifications or write for the Airtherm Catalog today. Our engineers will gladly work with you in planning efficient heat for your plant.

AIRTHERM MANUFACTURING COMPANY

722 South Spring Avenue • St. Louis 10, Missouri

Proper Maintenance Improves Condenser Performance

When head pressure of ammonia condensers increases, grease, oil, slime, rust, lime-scale build-ups on condenser tube surfaces must be suspected. You'll find the remedial procedure you want described in the Oakite "71 Digest." Here is discussed the speediest, most effective method of removing these saboteurs of heat transfer efficiency.

The Oakite "71 Digest," a compilation of plant-tested data based on case histories . . . thoroughly describes this and 70 other maintenance cleaning tasks that vitally affect equipment efficiency.

Write for your free copy of this interesting fact-filled Digest TODAY!

OAKITE PRODUCTS, INC., 58A THAMES ST., NEW YORK 6, N. Y.

Technical Service Representatives in All Principal Cities of the United States and Canada

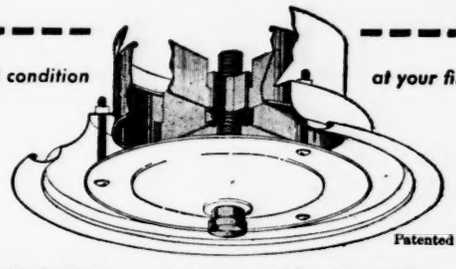
OAKITE Buy Bonds for Victory **CLEANING**

How to control supply-air diffusion

to meet specific job requirements and occupant desires.

Direction and volume of air discharged by every KNO-DRAFT Air diffuser can be adjusted quickly and accurately at any time for system balancing, ceiling heights, seasonal requirements, temperature differentials and the desires of the occupants.

Any desired condition *at your finger tip.*



Patented

KNO-DRAFT *Type K Adjustable Air Diffuser with Type D Volume Damper*

By simply turning the air adjustment screws (easily accessible from under the unit), the inner cone may be raised or lowered to secure any angle of air direction required. The built-in volume damper (regulated by the hand-turning knob) varies the air outlet aperture uniformly without affecting the outlet velocity or diffusion pattern.

Free Handbook: *Contains clear sketches, charts, dimension prints and instructive text that simplifies the selection and installation of air diffusers. Write Dept. E5*

W. B. CONNOR ENGINEERING CORP.

Air Diffusion *Air Purification* *Air Recovery*

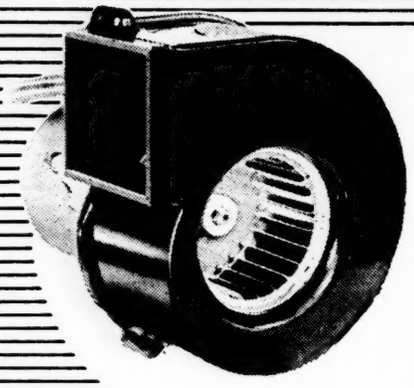
114 E. 32nd Street — W B CONNOR — New York 16, N. Y.

Highly Efficient Blower Units

MODEL J81
AXIAL FLOW BLOWER

Air Delivery (FREE AIR)
375 C.F.M. (NEMA)
140 C.F.M. (NAFM)

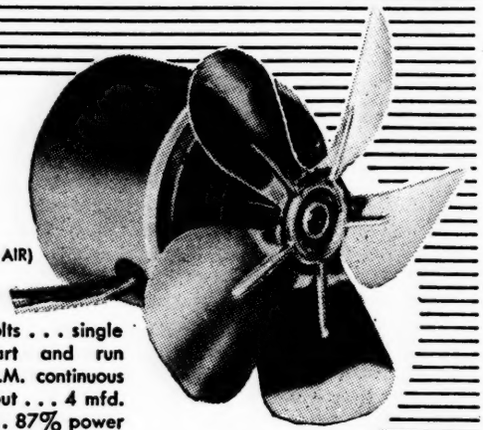
400 cycles . . . 115 volts . . . 6500 R.P.M. 50 watts input . . . 1.0 mfd. condenser required . . . 80% power factor . . . weight of unit 16 oz. . . . Starting torque 2.25 oz. in. Fan: 4 blade propeller type, 4" diameter.



MODEL J57
CENTRIFUGAL BLOWER

110 C.F.M. FREE AIR

60 cycles . . . 115 volts . . . single phase, capacitor start and run motor . . . 3300 R.P.M. 4 mfd. capacitor required . . . Weight of unit 3 lbs. 10 oz. . . . Overall width 5½" . . . Overall length 5¾".



MODEL J87
AXIAL FLOW BLOWER

Air Delivery (FREE AIR)
475 C.F.M. (NEMA)
175 C.F.M. (NAFM)

60 cycles . . . 115 volts . . . single phase capacitor start and run motor . . . 3300 R.P.M. continuous duty . . . 25 watts input . . . 4 mfd. condenser required . . . 87% power factor . . . weight of unit 3 lbs. 1 oz. . . . Fan: 5 blade propeller type, 5½" diameter.

EAD

EASTERN AIR DEVICES, INC.
585 DEAN STREET · BROOKLYN 17, N. Y.
An Affiliate of THE FRED GOAT CO., Inc. · Est. 1893

The **Welding Research Council** of the Engineering Foundation has announced the appointment of **W. Spraragen**, present executive secretary of the Council, to the newly-elected position of Director. The welding Research Council is a cooperative scientific research organization which is engaged actively in the study of matters related to the science and art of welding. Sponsored by the American Welding Society and the American Institute of Electrical Engineers it operates in close cooperation with all major engineering societies. It has an annual budget of more than a quarter of a million dollars and these funds for research are provided by large users of welding and welded products, and various governmental agencies.

W. Spraragen

Mr. Spraragen has long been identified with research and welding. He has served as Executive Secretary of the Welding Research Council since its organization in 1935 and his connection with the welding industry dates back to 1918 when he was appointed research assistant to the welding research committee of the National Council of Defense and the Emergency Fleet Corporation. From 1920 until 1934 Mr. Spraragen was secretary of the Division of Engineering, National Research Council, and secretary of the American Bureau of Welding from 1921 until 1936. He served as technical secretary of the American Welding Society from 1927 until 1942 and is editor and business manager of *Welding Journal*, official publication of the Society, of which he has been editor since publication was started in 1922. Mr. Spraragen was editor of the first two editions of the Welding Society and is the author or co-author of about 70 critical reviews of the literature on practically every phase of welding.

An important duty assigned to Mr. Spraragen in his new post will be the administration of the work of a Pressure Vessel Research Committee now being organized which contemplates the expenditure in this field of $225,000 over a three-year period.

R. A. Buescher has been appointed manager of the Great Lakes district of **General Electric's** appliance and merchandise department.

Since 1942, he has worked on war contracts for the industrial department with headquarters in Cleveland. In 1943 and up to the present time, he worked for the A. & M. department as an expediter on war materials.

Buescher joined G.E. in 1935 as a representative of the radio department, calling on company dealers throughout Ohio and Kentucky. He attended Ohio State and Western Reserve Universities.

Charles F. Codrington has been appointed assistant to the manager and **A. E. Caudle** has been appointed sales manager of the **Allis-Chalmers** blower and compressor department, Milwaukee, Wis.

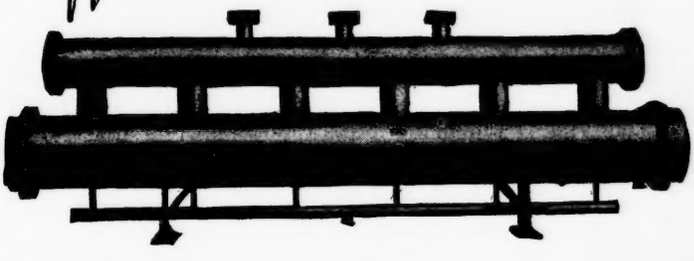
Mr. Codrington received an electrical engineering degree from Texas A & M and worked for the Badger Motor Company before joining Allis-Chalmers in 1930. He completed the graduate training course and also served in the engine and condenser department.

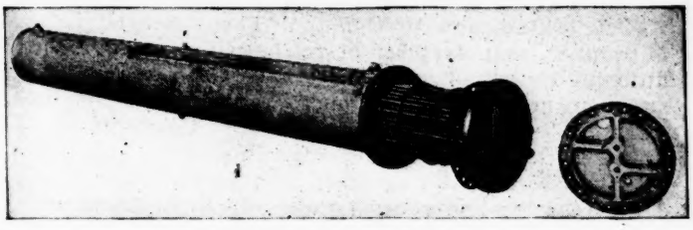
Mr. Caudle is a mechanical engineering graduate of Oregon State college and worked for the Badger Motor Company before joining Allis-Chalmers in 1939.

The Babcock & Wilcox Tube Co., Beaver Falls, Pa., long associated with the manufacture of stainless steel tubing, is now expanding facilities to include the manufacture of atomic hydrogen welded tubing and pipe.

Typifying
PATTERSON-KELLEY
Service and Products

FREON COOLERS
BRINE COOLERS
AMMONIA COOLERS





This is an engineering specialty in itself . . . a specialty that calls for an understanding not only of heat transfer phenomena but of refrigerants and their behavior. Calculations are not as simple as $2 + 2 = 4$.

That Patterson-Kelley is looked upon as specialists in this field is evidenced by the many "coolers" provided for refrigerating and air-conditioning systems throughout the country.

If you have any problem along these lines, or are working on some project, we would like to help.

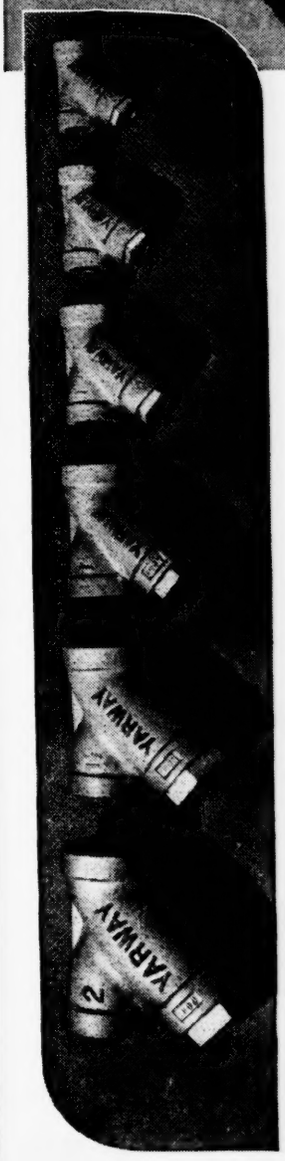
ARMY E NAVY

EST. 1880

THE PATTERSON-KELLEY Company, Inc.

Main Office and Factory
122 WARREN STREET, EAST STROUDSBURG, PA.
BOSTON 16, 96-A Huntington Avenue • NEW YORK 17, 101 Park Avenue
PHILADELPHIA 3, 1700 Walnut Street • CHICAGO 4, Railway Exchange Building
Representatives in All Principal Cities

A Better STRAINER

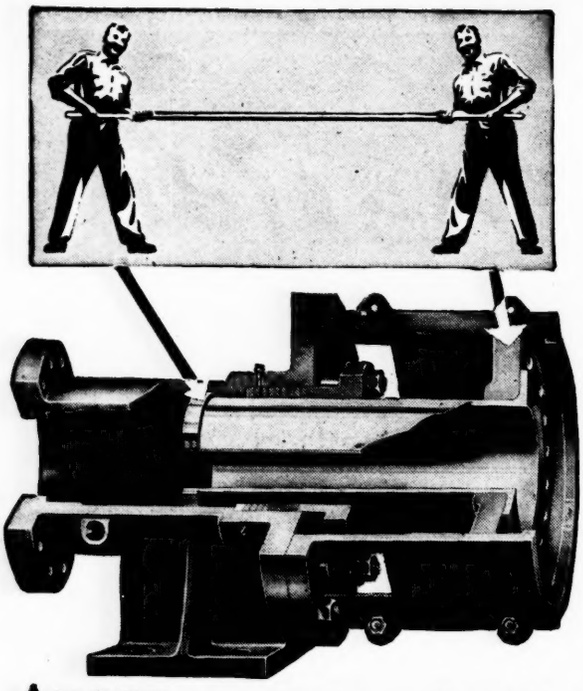


- Cadmium Plated Inside and Out
- High-Grade Woven Monel Wire Screen
- Readily Removed Steel Blow-Off Bushing
- Screen and Bushing Come Out Together — Go Back Together, Automatically Aligning
- For Steam Lines or Water, Oil and Other Fluids
- Reasonably Priced
- 6 Sizes from ½" to 2" for Pressures up to 600 lbs.
- Many Thousands in Service
- Sold by Over 100 Mill Supply Houses

See Your Supply House or Send for Bulletin S-200

YARNALL-WARING COMPANY
104 MERMAID AVE., PHILADELPHIA 18, PA.

YARWAY STRAINERS



ADSCO *Internally-Externally Guided*

EXPANSION JOINTS Keep The Slip In Perfect Alignment Because They Are Guided At Both Ends

Try to hold a pole at one end and keep it level. Then have someone hold the other end, and note the difference. That's precisely why the ADSCO Internally-Externally Guided Expansion Joint stays in alignment — why the slip moves through the packing space without undue pressure, distortion or scoring—why intervals between repacking are few and far between.

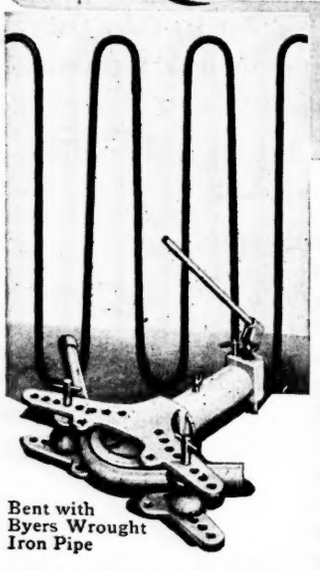
Write for Bulletin No. 35-20HV describing ADSCO Internally-Externally Guided Joints in sizes from 1¼" up with 4" or longer traverses.

AMERICAN DISTRICT STEAM COMPANY
NORTH TONAWANDA, N.Y.
MAKERS OF "UP-TO-DATE" STEAM LINE EQUIPMENT FOR OVER 65 YEARS.

Bend Pipe On The Job

Do it *Quicker-Easier* with

Tal's Prestal Pipe Bender



Bent with Byers Wrought Iron Pipe

You start saving valuable working time and reduce material costs the day you use a Tal Prestal Pipe Bender. This efficient, easy to operate, portable machine reduces by 60% the need for fittings or welds. It bends ⅜" to 3" wrought iron or steel pipe up to 180°, cold, in one single, fast operation without moving the pipe, without heating or filling. With a Tal Bender you get a job to be proud of, neat, smooth, workmanlike, free from kinks or wrinkles. Hundreds of leading contractors already know that this best engineered, money making machine repays its low cost over and over every few months. Write for bulletin . . . today!

TAL'S PRESTAL BENDER, INC.
Dept. H.V.7 • Milwaukee 2, Wisconsin

Buensod-Stacey, Inc., New York, has opened a branch office in Charlotte, N. C., to serve the Southern area of the country. Buensod-Stacey also has acquired the physical assets of **Page & Company. Jesse W. Page, Jr.** owner, has been elected to the staff of Buensod-Stacey, Inc., as a vice-president. Mr. Page will be in direct charge of the Page & Company Division. Operations of the **Southern area will be in charge of R. O. McGary,** vice-president of Buensod-Stacey, and the Charlotte branch will be manned by a complete engineering-contracting personnel. An office with a shop and warehouse has been acquired at 1001 North Church Street, P. O. Box 1755, Charlotte, N. C.

Burnham Boiler Corporation, Irvington, N. Y., has announced the appointment of **Ralph P. Henderson** as manager of a new branch sales office to be opened in Detroit, Michigan. This office will handle the sale of Burnham boilers and radiators in the Southern Michigan Peninsula. Temporary address is 21 Woodside Park, Pleasant Ridge, Michigan.

Homer G. Turner, research engineer of the **Anthracite Equipment Corporation,** died suddenly while on a business trip in Erie on May 17. Mr. Turner had been connected with Anthracite Equipment Corporation since 1934, making his headquarters at State College, Pa. He is survived by his wife, two daughters, and a son.

Construction of nearly 32,000 dwellings was authorized under the H-2 housing program during the month of May, bringing the total number of such units programmed since last November to almost 73,000 in 366 separate localities, Administrator John B. Blandford, Jr., of the **National Housing Agency** announced June 9.

E. B. Tilton, new president of **The Vilter Mfg. Co.,** Milwaukee, manufacturer of refrigeration and air conditioning equipment, announced June 15 that its control and management had passed to a group of employee executives. Mr. Tilton was formerly executive vice-president, treasurer and general manager.

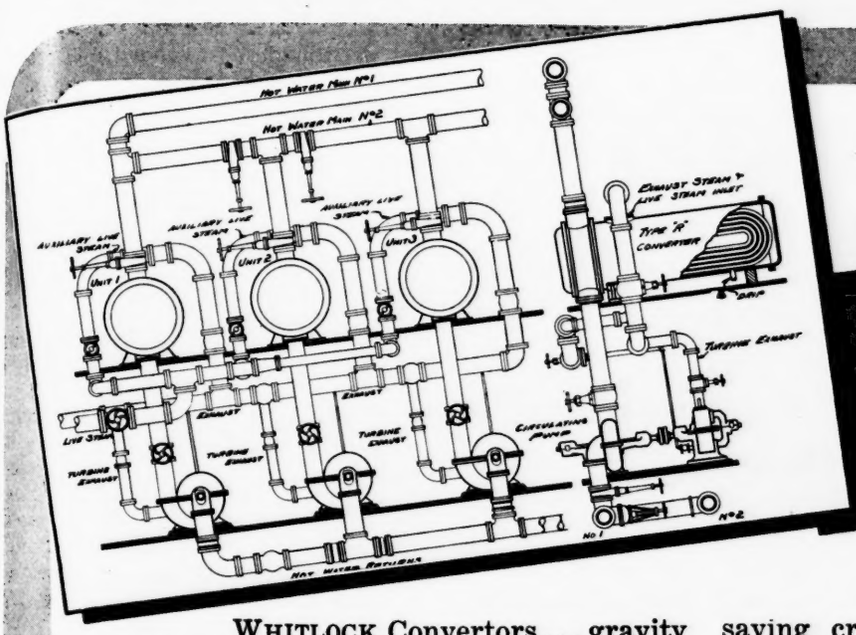
New officers of the company are: **E. B. Tilton,** president, treasurer and general manager; **A. A. Silverman,** vice-president; **L. E. Loos,** secretary and **M. F. Grady,** assistant secretary and assistant treasurer.

The reorganization comes six weeks after the former owners, members of the Vilter family, sold their stock for $1,300,000 to Foundation Inc., a charitable trust. Subsequently Vilter was completely separated from Foundation Inc., and is not now associated in any way whatsoever with Foundation Inc. or any other group, firm or business. Thus, Vilter is completely independent and will be operated under a board of directors consisting of Vilter employees. The board members are: E. B. Tilton, A. A. Silverman, L. E. Loos, manager of purchases, C. G. Bach, chief engineer, and W. L. Nahin, general sales manager.

The articles of incorporation of Vilter have been amended, so that it is now a non-stock corporation. The net profits of the Company will be used primarily for scientific research, for the benefit of employees of Vilter, for the rehabilitation of war veterans, and for educational purposes.

Raymond Viner Hall, consultant in radiant heating, announces the re-opening of his office for the practice of architecture at Lynn Hall, Port Allegany, Pa.

Aeroil Products Company has been adopted as the new name of the organization formerly known as Aeroil Burner Company, West New York, N. J., a manufacturer of oil-fired industrial equipment since 1917 and in recent years also in the gas-fired and electrically-heated equipment fields.



for

SPACE HEATING SYSTEMS USING HOT WATER

WHITLOCK CONVERTORS

WHITLOCK Convertors... gravity or forced circulation... save fuel and deliver full heat rating, year after year. The WHITLOCK forced circulation system above utilizes exhaust or live steam and has as advantages—small pipe sizes can be used, saving critical material; heating water may be efficiently carried long horizontal distances; relatively heavy overloads are easily handled; attendance costs are eliminated. Don't wait until Fall—order your heating equipment now!

LET US KNOW YOUR REQUIREMENTS

***The* WHITLOCK MANUFACTURING COMPANY**

40 SOUTH STREET, ELMWOOD, HARTFORD 1, CONN.

NEW YORK BOSTON CHICAGO PHILADELPHIA DETROIT RICHMOND

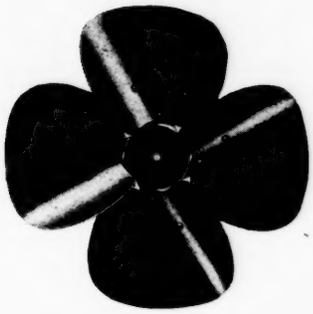
Authorized representatives in other principal cities.

In Canada: Darling Brothers, Ltd., Montreal

ESTABLISHED 1891 . . . AHEAD OF THE TIMES FOR HALF A CENTURY

AIR IMPELLERS

for every purpose

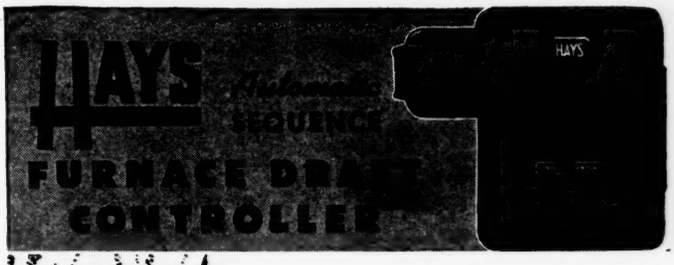


P SERIES PROPELLER FAN BLADE

One of the many Torrington fan blades and blower wheels available for your products in production lots. Designed primarily for pressure applications; made in 10", 12", 14", 16" and 18" diameters in several pitches.

While your product is *in the early design stages*, write us for an Air Impeller Specification Sheet.

THE TORRINGTON MANUFACTURING COMPANY, TORRINGTON, CONN.



NO BLOW BACK

FOR "ON" AND "OFF" FIRING EQUIPMENT

CONTROLS FURNACE DRAFT AUTOMATICALLY

FOR EFFICIENT COMBUSTION

Provides Automatic Control! In intermittent automatic firing, equipment cannot start under HAYS automatic sequence control until damper is wide open. This eliminates blow backs on either oil or stoker "On" and "Off" type installations. Further, it regulates damper for efficient combustion at all firing stages. Economical, easy to install, widely used in both small and large installations. Full description in HAYS Booklet 41-489. Send for it today.

The HAYS CORPORATION

SINCE 1901 COMBUSTION INSTRUMENTS AND CONTROL

MICHIGAN CITY, INDIANA, U.S.A.

Oiljak, like other American manufacturers, continues to devote all its facilities to the production of war material, to speed the approaching day of victory.

Yet, at the same time, we consider it no less our duty to plan for the future, to do our part in easing the change-over to a healthy industrial economy during the competitive peacetime years that lie ahead of American industry.

Oiljak offers you complete manufacturing facilities with up-to-date machines operated by men whose production record on war contracts compares favorably with normal peacetime costs; a record achieved by a minimum of rejections, a steady streamlined flow of work and materials through the plant, and a special assembly-line technique for which Oiljak is famous.

So before you set up the manufacturing procedure for *your* peacetime products, it may well be worth your while to get acquainted with all the facilities which Oiljak can offer you.

MACHINING • STAMPING WELDING
PLATING • FINISHING ASSEMBLING

METAL MANUFACTURERS

The OILJAK Mfg. Co. INC.

MONTCLAIR, NEW JERSEY

THE JOB COMPLETE FROM BLUEPRINT TO FINISHED PRODUCT

Ray G. Whipple, treasurer and general manager of **Harvey-Whipple, Inc.**, has appointed **Leonard F. Connor** as assistant treasurer.

Mr. Connor has served with Harvey-Whipple for a total of thirteen years, eight years as purchasing agent, and more recently, five years as secretary. His new position has been made necessary by the rapidly expanding business of the Springfield (Mass.) firm.

D. A. Newton has joined the **F. J. Evans Engineering Co.**, Birmingham, Ala., with branch offices at Atlanta and Houston, as air-conditioning engineer of the heating and air conditioning division. Mr. Newton will make his headquarters at the Atlanta office.

Before joining the F. J. Evans Co., Newton was chief engineer of Larkin Coils, Inc., Atlanta, manufacturers of air conditioning equipment. Prior to that time he was located in the central engineering division of the U. S. Rubber Company, at New York City. For twelve years previous he was with the Carrier Corporation, making a total of ninteen years experience in the air conditioning field, following his graduation in mechanical engineering from the University of Kentucky.

Nelson B. Buehrer has become a new member of the firm with headquarters at the general offices in Birmingham, Ala. He will direct sales of heating and air conditioning equipment to the dealers and gas utilities served by the company throughout the south.

Mr. Buehrer was formerly with Surface Combustion Corp., Toledo. Evans Engineering is manufacturer's agent for the Toledo company's complete line of products. Before Pearl Harbor, Mr. Buehrer was Surface Combustion's regional sales manager for an area comprising Ohio, Michigan, Kentucky, West Virginia, and parts of Pennsylvania, Indiana, New York and Canada.

Arnold W. Plier has been named assistant general manager in charge of production of the **D. J. Murray Mfg. Co.**, Wausau, Wisconsin, according to a recent announcement from the company. In March Mr. Plier was elected secretary of the company. His present position consists of additional duties in which he will direct all work pertaining to production.

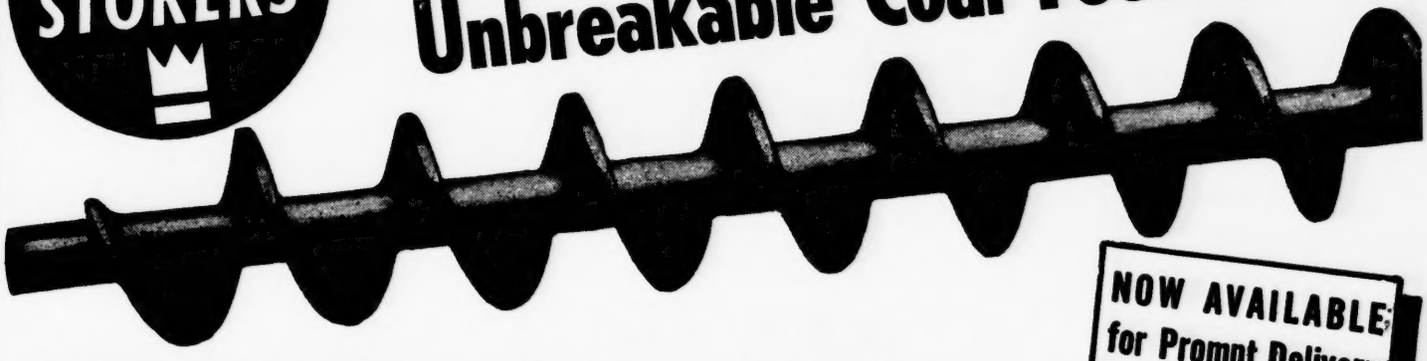
Mr. Plier has been with D. J. Murray Manufacturing Co. since 1930, in the cost and production departments. Prior to that time, he was employed for a number of years in the cost and production departments of several Wisconsin paper mills.

Through the cooperation of the leading technical schools and universities, theses for Master degrees that are of importance to industry and research, will be indexed in the technical "Digest-Index" issued by **The National Research Bureau, Inc.**, 415 North Dearborn Street, Chicago 10, Illinois. They will be supplied on microfilm through the Library of Industrial Research, a non-profit organization, acting as clearing house for the exchange of technical, scientific and management information.

Bituminous Coal Research, Inc., agency in charge of investigational and developmental work for the bituminous coal industry, has announced the appointment of **T. A. Day** of Huntington, W. Va., as special representative. He will conduct public relations activities of BCR and maintain contact with members, coal producers, associations of coal mining companies, railroads and manufacturers of coal-burning equipment for homes and industries. He joined the BCR staff in Pittsburgh June 1. Mr. Day was formerly with Island Creek Coal Sales Company which he served as special representative from 1941 until May 31 of this year. He joined the Island Creek organization after having been associated with Appalachian Coals, Inc. in Cincinnati, O., and Knoxville, Tenn., from 1934 to 1941.

For STOKERS

The CROWN Unbreakable Coal Feed Screw



NOW AVAILABLE for Prompt Delivery

WELDED All-Steel Worm—All Sizes—All Pitches

★Crown's complete line of all-steel Coal Feed Screws meets every replacement and production requirement. Produced for both domestic and industrial stokers. Crown Screws are available with right or left hand screw, in all sizes and pitches, tapered or straight, and in combinations of pitches. Uniformly smooth surfaces insure that coal will flow freely and easily through the flights. Because it is all-steel with continuous weld, the Crown Coal Feed Screw guarantees long, continuous operation with full customer satisfaction. Crown is in a position to make prompt delivery on all sizes.

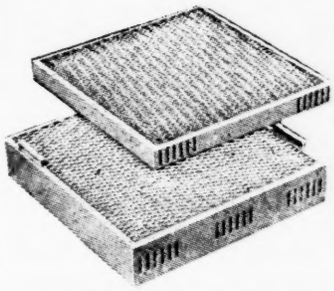
In ordering give complete specifications on size and design.

CROWN IRON WORKS COMPANY

1207 Tyler St., N. E. *Since 1878* **Minneapolis, Minn.**

SEEKING PROFITABLE NEW LINES?

Check up on the BADGER Heavy Duty Industrial Filter . . . Franchises are Available.



BADGER HEAVY DUTY INDUSTRIAL FILTER
2" and 4" Sizes

A large and profitable market awaits your introduction of this permanent type "BADGER" Filter—specially designed for extra heavy duty and industrial air cleaning services. Extensive use of this highly efficient "BADGER" Filter shows results definitely measured in terms of improved air filtering, greater dust-holding capacity, reduced maintenance costs.

Write for details about our protected distributorships, territories available, and prices and discounts

Badger CORPORATION

331 East Brown Street **Milwaukee 12, Wisc.**

PEERLESS PUMPS

Peerless

NOW MANUFACTURES

HORIZONTAL

AS WELL AS

VERTICAL

PUMPS

WITH THE ACQUISITION OF

DAYTON-DOWD COMPANY

BY THE PEERLESS PUMP DIVISION

MACHINERY

Peerless Pumps VERTICAL & HORIZONTAL

PEERLESS PUMP DIVISION Food Machinery Corp

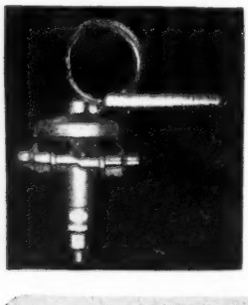
LOS ANGELES 31 CALIF ★ QUINCY ILLINOIS ★ CANTON 6 OHIO

RETAILERS LAUD OUTSTANDING WORK of REFRIGERATION SERVICE ENGINEERS

This afternoon, in some distant city, a butcher with his walk-in cooler containing precious red-point meats, places a hurry-up call for a refrigeration service engineer — something is wrong with his refrigerating equipment.

The butcher faces loss of money, loss of meat and wasted points. But, this very night, a *refrigerating service engineer* works to set that equipment working again. Saving the butcher money, protecting his produce . . . helping him to stay in business.

On that service call, A-P DEPENDABLE Refrigeration Controls went along too. It's a fact, leading refrigeration service engineers depend on A-P DEPENDABLE Refrigeration Controls to help make their service calls 100% successful.



AUTOMATIC PRODUCTS COMPANY

2462 North Thirty-Second Street
Milwaukee 10, Wisconsin

Export Department, 13 E. 40th Street, New York 16, N. Y.

A-P Model 220 K Thermostatic Expansion Valve. Capacity to 16 tons Freon.

DEPENDABLE *Refrigerant Valves*

Stocked and Sold by Good Refrigeration Jobbers everywhere. Recommended and Installed by Leading Refrigeration Service Engineers.

Fluid Controls Company, 18 W. Chelten Avenue, Philadelphia, has been appointed exclusive valve distributors for R-S Products Corp., Philadelphia.

The territory includes the Pennsylvania counties east of and including Potter, Clinton, Center, Huntington and Franklin; New Jersey counties south of and including Warren, Hunterdon, Mercer and Monmouth; and all of the State of Delaware.

Thermoid Co., Trenton, N. J., announces that **H. W. Overman** has been placed in charge of industrial friction materials. Previous to his recent association in his father's business, Mr. Overman was with Ferodo Asbestos, Inc., for nine years. During the last four years with Ferodo, he was in charge of original equipment sales to both industrial and automotive customers. He is a mechanical engineer and a member of the Society of Automotive Engineers.

Daniel A. Herrick has been appointed manager of sales of d'Este Division of **American Chain & Cable Company, Inc.,** with headquarters at Reading, Pa. Although this is a new division of the company, the d'Este line of automatic regulating valves, pressure reducing valves, tank and float valves has been made by the company for some time, and Mr. Herrick has been active in the sale of these products for several years.

Titled "The Manufacture of Dies," a new **Allegheny Ludlum Steel Corp.,** 16mm. sound and color film, running time 10 minutes, is announced by the company, and is available for use upon request. It describes the manufacture of lamination dies from Huron, High Carbon-High Chromium die steel. The new film supplements others already available covering stainless, tool, and electrical steels. Address Allegheny Ludlum Steel Corp., Brackenridge, Pa.

Instruments and Controllers

Schematic drawings to show typical applications are contained in "Hays Instruments and Controllers in Industry," a booklet of 26 pages. Included are instruments and controls for pressure reducing, pressure relief, rate of flow, turbine-driven compressor control, control of speed, liquid level and density.—*The Hays Corp., Michigan City, Ind.*

Sintered Magnets

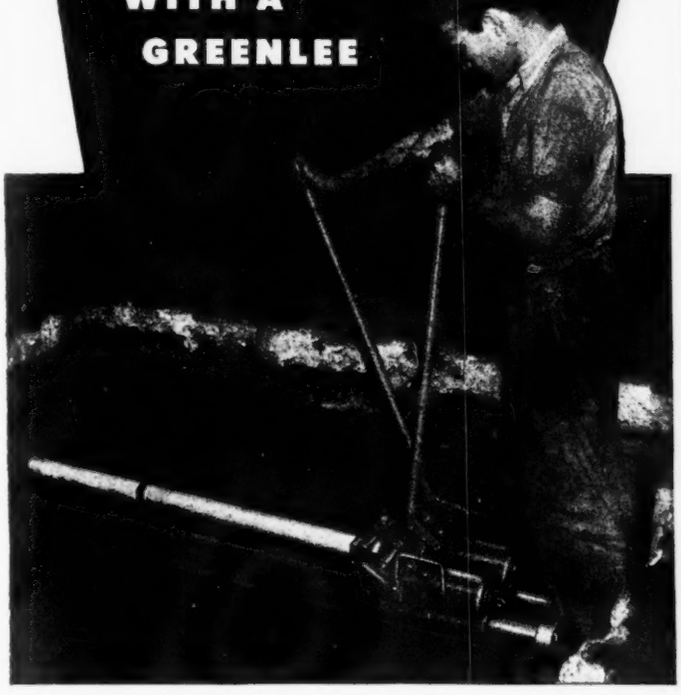
A 20-page booklet describing the manufacture and uses of sintered-alnico (aluminum, nickel and cobalt are normal constituents) magnets. Magnets are made from mixtures of powdered metals pressed into desired shapes. Booklet outlines magnetic and mechanical properties and shows dimension diagrams and specifications of standard forms in general use.—*General Electric Co., Schenectady, N. Y.*

Rivnut Data Book

A 40-page data book giving complete information on Rivnut, a one-piece blind fastener that can be used as a blind rivet. Selection of the proper Rivnut is given in detail.—*The B. F. Goodrich Co., Akron, Ohio.*

PUSH PIPE UNDER OBSTACLES....

WITH A GREENLEE



One man can push pipe through the ground easily, quickly with a GREENLEE Hydraulic Pipe Pusher—under streets, sidewalks, lawns, concrete flooring and other obstacles.

Cut costs, save manpower on underground pipe installations this easy way . . . eliminate tearing up, tunneling, backfilling, tamping, re-paving. No extensive trenching, as short trench accommodates Pusher.

Easy to operate . . . easy to carry and set up . . . powerful GREENLEE Pushers develop up to 75 tons pressure for your big jobs and operate at 6 speeds for varying soil conditions. A GREENLEE pays for itself in man-hours saved on first few jobs. For complete facts and price on time-and-money-saving GREENLEE Hydraulic Pushers, send today for free booklet S-117. Greenlee Tool Co., Division of Greenlee Bros. & Co., 2327 Twelfth St., Rockford, Illinois.

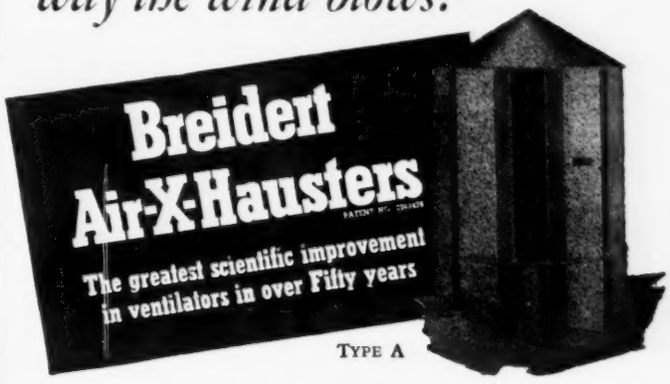
Get Ready with Greenlee!

REGISTERED TOOLS

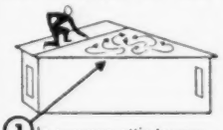
GREENLEE

FOR THE CRAFTSMAN

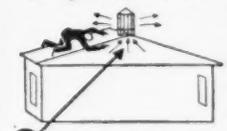
Better ventilation without power costs...no matter which way the wind blows!



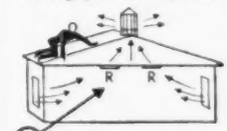
Because of the revolutionary, aerodynamically-correct design of the Breidert Air-X-Hauster, wind currents striking it from *any* angle are converted into a powerful suction force that rapidly exhausts stale air from the interior of the house, kitchen or building. The Breidert remains stationary, has no moving parts. *Back-drafts are eliminated where there is no interior negative pressure!*



(1) In summer, attic temperature often reaches 30° to 40° higher than outdoors.



(2) Breidert Air-X-Hauster exhausts hot, stale air at the high point of roof, and...



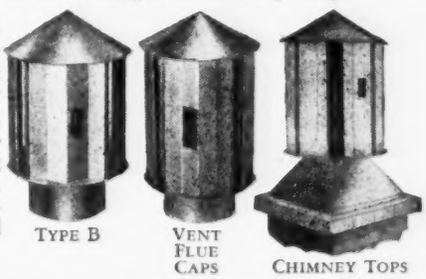
(3) Fresh air enters at windows and doors, passes through register openings (R) and into attic, cooling entire house.

Unsurpassed for Kitchen Ventilation . . . The Breidert system provides a continuous, silent, effective circulation of air that exhausts heat and odors *at their source*, with no operating or maintenance expense. There are no "hang-over" cooking odors because the exhaust action of the Breidert is continuous. The neat, compact appearance of the "Type A" Breidert (above) especially recommends it for residences.

Higher Capacities Certified by Smith, Emery . . . Commercial laboratory* tests, made with wind blowing at *all* angles, prove the remarkably high capacities of the Breidert. Certified ratings are based on these unusual tests. **Smith, Emery & Co., Pacific Coast Branch Pittsburgh Testing Laboratories.*

Breidert Air-X-Hausters for Roofs, Vent Flue Caps, Chimney Tops

Breidert Air-X-Hausters provide safe, sure ventilation no matter which way the wind blows, eliminating backdraft and resulting annoyances. Thousands of installations have proved their superiority.



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. . . contains specifications and installation data, certified capacity ratings, etc. Address Dept. R

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Airco Electrodes

A 56-page book containing a combined electrode selector chart and index, illustrated sections on mechanical properties and testing and on approvals and a full color page showing color markings of various electrodes.—*Air Reduction, 60 East 42nd Street, New York 17, N. Y.*

Warm Water Radiation and Hot Water Supply

Specialties for warm water radiator heating systems and modern water heaters of both tankless and storage tank types are shown and described in a new 20-page catalog. Detailed information includes layout diagrams, design tables and installation data on one-pipe and two-pipe systems as well as various accessories—circulators, venturi fittings, flow checks, relief and reducing valves, etc. Specify Catalog D99.—*Taco Heaters Inc., 342 Madison Ave., New York 17, N. Y.*

Electric Controls

Bulletin F-2287-1 discusses the Barber-Colman electric system of temperature control which is available for heating, ventilating, air conditioning, and industrial applications. Described in the bulletin are the various room, duct, immersion, and remote bulb thermostats which are available. It also describes the complete line of motor-operated valves, control motors, and package sets of control equipment available for the maintenance of water temperatures in hot water storage tanks.—*Barber-Colman Co., Rockford, Ill.*

Axial-Flow Fans

Illustrated folder describes several types of axial-flow Propellair fans.—*Propellair, Inc., Springfield, Ohio.*

Leather Packings

Design and Application of Hydraulic and Pneumatic Leather Packings, a spiral bound handbook and catalog of 63 pages. In addition to the conventional shape packings, mention is made of the synthetic materials for packing. Included in the line is a V-packing of leather and synthetic rubber between plastic adapters.—*Chicago Belting Co., 113 N. Green St., Chicago, Ill.*

Surface Grinding Set-ups

An 8-page folder entitled Speed Surface Grinding Set-Ups is illustrated with actual applications of Magne-Blox products used to hold various types of work for surface grinding. Featured also is a line of special sizes of Magne-Blox parallels, v-blocks and angle irons, as well as other shapes and forms to fit any type of magnetic chuck.—*George Scherr Co., 200 Lafayette Street, New York 12, N. Y.*

Rubber Blow and Spray Guns

A 22-page booklet on the Lonn rubber blow and spray guns and water savers explains the principle of Lonn valves which have only three working parts and give constant fingertip control of air or water under pressure without the use of levers, springs, push buttons, packings or screws.—*B. F. Goodrich Co., Akron, Ohio.*

Induction Heating

Four-page folder, B6372, describes the company's new electronic heaters for induction and dielectric heating. Mercury arc converters are described in B6373, an 8-page booklet. Besides presenting the details of the converter, it tells of the advantages of induction furnace heating over old methods.—*Allis-Chalmers Mfg. Co., Milwaukee 1, Wis.*

Cast Iron Fin Type Radiation

A six-page folder describing the cast iron "fin" type radiation, design and construction. Contains charts and illustrations, with installation views of cast iron grid Unit Heaters, dimensional drawings, capacity tables, supply and return connections drawings.—*D. J. Murray Mfg. Co., Wausau, Wis.*

Blind Rivets

Instructions on the selection and use of Huck blind rivets are contained in a 16-page illustrated manual. Facts are also given on the proper use of the rivet gun. —*Huck Manufacturing Co., 2480 Bellevue Ave., Detroit 7, Mich.*

Resistors

Descriptions of various forms of resistors are given in a booklet "Resistors," containing 32 illustrated pages. Sizes and details are given for each type.—*Ward Leonard Electric Co., Mt. Vernon, N. Y.*

Unit Heaters

Features of the Thermolier unit heater are presented in catalog 6-E of 32 illustrated pages. Production has been resumed with copper tubes because the government has made copper again available for unit heaters.—*Grinnell Company, Inc., Providence 1, R. I.*

Temperature Controls

Illustrated folder describing several models of temperature controls for industrial use.—*Burling Instrument Co., 253 Springfield Ave., Newark 3, N. J.*

Equalizing Valves

Folder giving trade prices for Gorton equalizing valves and air eliminators.—*Gorton Heating Corp., Cranford, N. J.*

Getting Personal

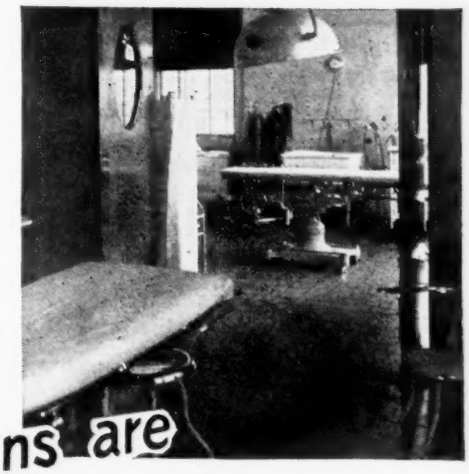
Lawrence R. Babcock (Fuel Oil for Heating and Steam Generation, page 67) is a "Down Easter." He was born in Newburyport, Mass.

He studied naval architecture and marine engineering at Webb Institute in New York City.

Lawrence R. Babcock

His first experience with oil burners was as a fireman on a freighter. He became associated with Petroleum Heat and Power Co., Stamford, Conn., in 1926, and is now manager of its field engineering division. Mr. Babcock is a member of the American Society of Mechanical Engineers.

Two operating rooms in a 75-bed hospital, which are air conditioned with Frick equipment.



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Hospitals are finding year 'round air conditioning an indispensable aid in operating rooms. Patients, doctors, and staff are all greatly benefited by its controlled temperatures and invigorating freshness.

Years of experience in this work have taught us how best to satisfy the special requirements of operating rooms.

High relative humidity is necessary to carry away static electricity; explosion-proof motors and switches are used; fresh conditioned air is admitted in unusually large proportions: controls are automatic, but can be instantly adjusted by the surgeon. Drafts, noise, dust, and unsteady conditions are avoided.

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DEPENDABLE REFRIGERATION SINCE 1862

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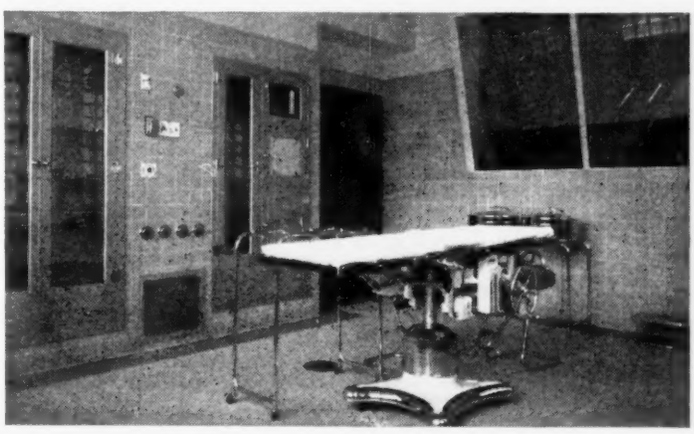
The Detroit Osteopathic Hospital Uses Frick Air Conditioning in this Operating Room



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Multi and FHP Belts available in A-B-C-D widths and all lengths.

Bronze and ball bearing pillow blocks and other transmission appliances carried in stock.

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A shutter with aluminum louvers. Completely weatherstripped, insuring an exceptionally snug, tight fit, and also freedom from louver flutter. Yet it is more sensitive to air currents than any other shutter on the market, and has swivel joints that never get loose or rattle.

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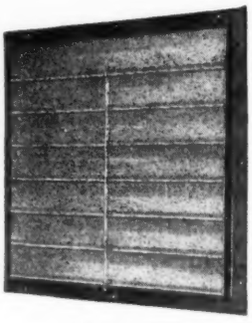

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Front View (Closed)

Free CATALOG

ELGO SHUTTER & MANUFACTURING CO.

6968 W. Jefferson Detroit 17, Mich.

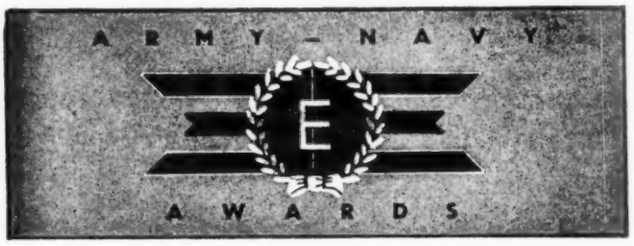
INDUSTRIAL DEGREE-DAYS

May, 1945

City	55F Base	45F Base
Baltimore, Md.	22	0
Buffalo, N. Y.	188	27
Chicago, Ill.	129	12
Cleveland, Ohio	122	7
Detroit, Mich.	156	12
Indianapolis, Ind	66	0
New York, N. Y.	35	0
Philadelphia, Pa.	33	0
Pittsburgh, Pa.	64	0
St. Louis, Mo.	49	0

Canadian Degree-Days

The Canadian degree-days for May, 1945 will be published in next month's issue in a summary of degree-days for the Canadian heating season from September 1 to May 31, presenting both current and normal figures.



American Blower Corp., Detroit, Mich.
(Fifth star)

Buffalo Forge Co., Buffalo, N. Y.
(Fourth renewal)

Kewanee Boiler Corp., Kewanee, Ill.
(Fourth star)

McCord Corporation, Detroit, Mich.
(Sixth award)

Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
(Fifth award)

Owens-Corning Fiberglas Corp., (Huntington, Pa., plant)

Plant Rubber & Asbestos Works, San Francisco, Calif.
(Third star)

BRIEF REVIEWS

WATER HEATERS—The National Electric Manufacturers Association has issued Test Specifications for Automatic Electric Storage Water Heaters. The standards (Publication No. 103, price 50 cents) cover voltage ratings, pressure ratings for tanks, wattage ratings of elements for single and twin-unit heaters, temperature settings, differentials, and adjustment ranges for thermostats.

NEMA Standards for Electric Water Heaters (Publication No. 45-104, price 25 cents) provide practical information concerning performance, rating, testing and manufacture of electric water heaters. Association is located at 155 E. 44th St., New York, N. Y.

AIRPLANE CONTROL TOWERS—An article in the May-June issue of Weather Magic, the house organ of The Trane Co., La Crosse, Wis., describes how to air condition an airplane control tower.

HEATING AND VENTILATING'S

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Blueprints
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Helpful information in concise form for the heating and air conditioning engineer and contractor. HEATING AND VENTILATING'S famous Reference Sections, Blueprints and Special Sections are now available as pamphlets, price 5 for $1; or 25 cents each.

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Underground Steam Piping
Industrial Exhaust Ventilation
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What the Air Conditioning Engineer Should Know About Lighting
Wartime Design Restrictions for Conservation
Oil to Coal Conversion
Pipe Sizing
Liquid Vapor Heat Exchangers
Coal for Heating and Steam Generation
Central Steam Heating
Convection Drying and Drying Calculations
Electrothermal Space Heating and Air Conditioning
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Solvent Vapors and Their Control
Summary of Design Data for Exhaust Systems
Fuel Oil for Heating and Steam Generation

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Please send me the following pamphlets for which I enclose stamps, money order or check. 7/45

Titles.....

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Your name .....

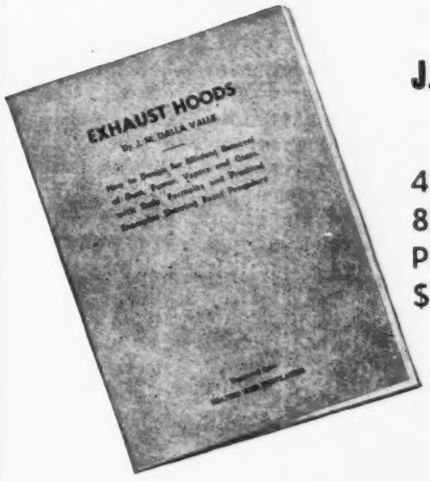
Street address.....

City and State.....

Firm.....

Position.....

EXHAUST HOODS



by
J. M. Dalla Valle

49 pages,
87 illustrations.
Paper bound.
$1.00 per copy.

The effectiveness of local exhaust ventilation depends to a considerable extent on the design of a suitable hood or opening. This reprint of the complete series "How to Design Exhaust Hoods" which appeared in HEATING AND VENTILATING, shows how to design such a hood and gives data, formulas and practical examples indicating the exact procedure. Contents: Theory of Flow of Gases Into An Opening—Velocity Characteristics of Unobstructed Openings—Velocity Contours of Hoods With Special Boundary Conditions—Criteria for Determining Hood Effectiveness — Hoods for Dust Control: Total Enclosures and Screening—Hoods for Dust Control: Partial Enclosures for Grinding —Hoods for Dust Control: Partial Enclosures, Miscellaneous—Hoods for Control of Fumes, Mists, Vapors and Gases—Booth-Like Structures for Fumes, Vapors and Gases—Grille-Type Openings Under Suction — Hood Entrance Losses. Examples of Calculation Required in Designing Hoods.

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SALESMEN'S OPPORTUNITY

OPEN NOW

Four or five men with heating or combustion backgrounds are wanted at once by an equipment manufacturer for trade-contact marketing work in established territories. Selling ability and experience are essential. Knowledge of, and liking for, mechanics or engineering will be very helpful in this work.

The type of man most likely to be successful in this particular work could be a technical school graduate who has had a couple of years or more experience in selling heating equipment, power plant specialties, combustion control equipment, stokers or oil burners to wholesale distributors and, or, installing contractors. However, a college degree is not a first essential. A practical working knowledge and some experience in heating and power plant work coupled with sales ability is what the job requires.

The Company that wants these men is old and well established in this field. It is respected, progressive, well financed, and is currently planning further expansion and progress in its products and markets. These plans definitely include aggressive promotion and marketing to re-inforce the personal efforts of its representatives.

The line is already well known to the trade and the public and has an enviable performance record and users' satisfaction of many years standing. This line is now in process of further refinement and expansion. Its market is international and growing.

All the men now in this company's marketing division have read this advertisement and agree it is a fair and conservative outline of an opportunity. It is a competitive field, and the work will be varied and interesting, but not attractive to anyone looking for a "pushover".

Every response to this advertisement will receive executive consideration. No inquiries will be made until after an interview has provided a basis for such inquiry and the applicant has authorized it. Interviews can be arranged at practically any time and place, and will be requested on the basis of personal and business experience data in the responses received. It is requested that such data be complete and specific enough to provide an informative outline.

Box 429

HEATING AND VENTILATING
148 Lafayette Street
New York 13, N. Y.

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(Plumbing-Drainage)
(Heating-Ventilating)
DRAFTING DEPARTMENT

also Architectural, Steel, Concrete, Mechanical, Piping and Electrical Draftsmen, Permanent Positions, 40 hours week at regular rate, 10 hours week at time and half rate. Gilbert Associates, Inc., Engineers and Consultants, Reading, Pa.

WANTED—MECHANICAL ENGINEER with general experience in heating, refrigeration, air conditioning and ventilation. Experience in estimating, designing and field work for steam heating and process piping essential; some experience in die and tool work desirable. Position with established contracting and manufacturing firm operating in Middle Atlantic and Southeastern States. Give age, education, previous experience. Salary commensurate with ability and experience. Statement of availability required. Box No. 426, HEATING AND VENTILATING, 148 Lafayette St., New York 13, N. Y.

WANTED — ASSISTANT SALES MANAGER. Manufacturer of a complete line of Axial Blowers and Fans in Southern Ohio requires the services of a not too old, alert and vigorous man with push. Fan experience and engineering education preferable. Excellent future for right man. Statement of availability required. Box 427, HEATING AND VENTILATING, 148 Lafayette St., New York 13, N. Y.

WANTED, alert, practical engineer to assist owner of a small New York contracting firm specializing in liquid handling systems for food plants. Must be familiar with industrial piping, capable of making own drawing, supervising men, and estimating costs. This is an expanding business with an excellent future. Box No. 438, HEATING AND VENTILATING, 148 Lafayette St., New York 13, N. Y.

MANUFACTURERS' representative operating in Philadelphia and surrounding territory is interested in taking on a few additional non-competitive lines. Box No. 437, HEATING AND VENTILATING, 148 Lafayette St., New York 13, N. Y.

NEED A DISTRIBUTOR?

Sales executive with twenty-four years sales and engineering experience, capital and wide trade acquaintance, wants heating, air conditioning and allied lines for Chicago area. Box 439, HEATING AND VENTILATING, 228 N. La Salle St., Chicago, Ill.

WE ARE interested in securing the services of a Designing Engineer familiar with Low Pressure Boilers for commercial and household use. Permanent connection. Replies held confidential. Send letter stating age, draft status, education and past experience. Statement of availability required. Box 430, HEATING AND VENTILATING, 148 Lafayette St., New York 13, N. Y.

EQUIPMENT WANTED—Used and Surplus refrigeration and air conditioning equipment is in demand. Wire us for speedy action at the highest cash price. Parts, units and complete systems all sizes, condition, anywhere. E. M. FAIRBANKS COMPANY, 2548 E. Tremont Ave., New York 61, N. Y.

SAVE vital trucks, gasoline and tires. Reduce costs. Not too late to start automatic fuel oil truck deliveries. Write us. Degree Day Systems, 5106-39th Avenue, Woodside, N. Y.

2 FEED WATER HEATERS FOR SALE

1 Cochrane and 1 Griscom-Russell Open Feed Water Heaters. Good condition. Write or phone J. E. Shanahan, Jr., International Harvester Company, 180 North Michigan Ave., Chicago 1, Illinois. Phone ANDover 4200.

The Pace of Victory Permits Only A Congratulatory Handshake!

American Industry well merits a decoration for its brilliant record in the Mighty 7th! But, as our newly decorated Pacific heroes quickly return to combat, so industrial leaders aren't resting on their laurels. ***Back into Bond action***—they are now busy consolidating recent Payroll Savings Plan gains!

First, many executives are now patriotically working to retain the substantial number of new names recently enrolled during the 7th War Loan. By selective resolicitation, they are urging all new subscribers to maintain Bond buying allotments.

Second, many are also employing selective resolicitation to urge every worker who increased his or her subscription in the 7th to continue on this wise, saving-more-for-the-future basis.

Help to curb inflationary pressures and harvest peacetime prosperity by holding the number of Payroll Savings Plan subscribers—and amounts of individual subscriptions—to the mark set in the Mighty 7th!

The Treasury Department acknowledges with appreciation the publication of this message by

HEATING AND VENTILATING

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Yarnall-Waring Co. 117
York Heat, Div. of York-Shipley, Inc. ..... *
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*Advertisement appeared in preceding issue.

Only HENRY makes a Diaphragm Packless Valve that is NON-DIRECTIONAL

● Experience has taught the refrigeration industry that in a Henry Product it can always reasonably expect some extra value and a better feature of design and construction. The Henry Packless Valve is an outstanding example.

By means of a patented balancing channel in the lower valve stem, explained in detail below, the Henry Diaphragm Packless Valve cannot stick shut regardless of the pressure differential above or below the valve seat. When using a conventional valve, there is always the possibility that a valve installed in reversed position could fail to open if sufficiently high pressures should develop above the seat. The Henry Diaphragm Packless Valve, however, can be relied upon to give positive performance under all conditions of service because it is truly non-directional.

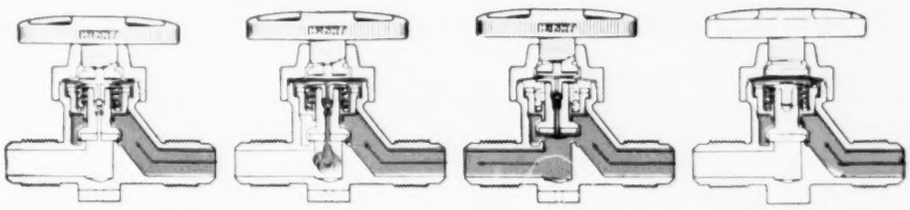
You will also like the Henry feature of having inlet and outlet ports in line on two way and three way valves. This eliminates tube bending and results in neater lines and lower installation costs.

During the war Henry Diaphragm Packless Valves have been widely favored by all branches of the armed services. It is only natural that, as our country gradually turns to the problems of Peace, this Henry Product again will be the logical choice of manufacturers, jobbers, contractors and service organizations everywhere.

The Difference Between a Henry Non-Directional Balanced-Action Diaphragm Packless Valve and a Conventional Packless Valve

Available in a complete range of sizes with flare or solder connections.

SOLD BY JOBBERS



BALANCED-ACTION VALVE IN CLOSED POSITION—High pressure above the seat, low pressure below the seat. High pressure regions are shown in color. Pressure in spring cage below diaphragms is the same as that in main passage of valve body above the seat. This is due to seepage between the lower stem and the guide. Downward pressure of the bearing plate on the diaphragms seals the upper port of the balancing channel.

OPENING THE BALANCED-ACTION VALVE—As hand wheel is turned to open valve the diaphragms, because of pressure beneath them and their own snap action, rise and expose the upper port of the balancing channel. The high pressure, shown in color, unseats ball check and is instantly released through the open channel to the low pressure region below the valve seat, thus achieving "balanced-action" by equalizing pressures.

BALANCED-ACTION VALVE IN FULL OPEN POSITION—Equalization or balancing of pressures above and below the seat, as shown in color, guarantees that this valve can never "stick shut" but will always open positively, regardless of original differential in pressures. When there is high pressure below the seat and low pressure above, the balanced valve opens easier than other types because of the light weight spring.

CONVENTIONAL TYPE WITHOUT BALANCED-ACTION—As hand wheel is turned to open valve the diaphragms rise. When the differential between high pressure, shown in color, above seat and low pressure below seat is greater than force exerted by heavy spring, stem "sticks shut"—valve remaining closed. The heavy spring required in this type of valve greatly increases diaphragm wear and strain and causes stiff closing.

HENRY VALVE COMPANY

HENRY VALVE CO.

3260 WEST GRAND AVENUE, CHICAGO 51, ILLINOIS

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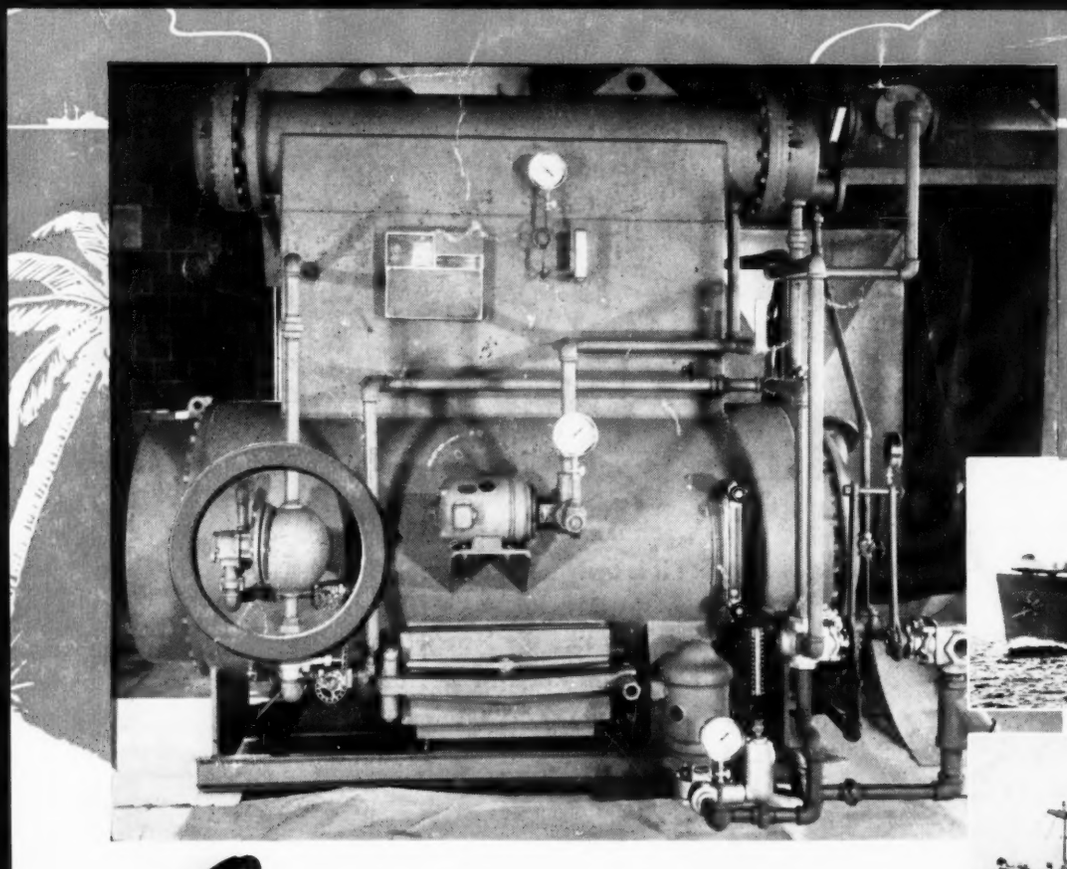
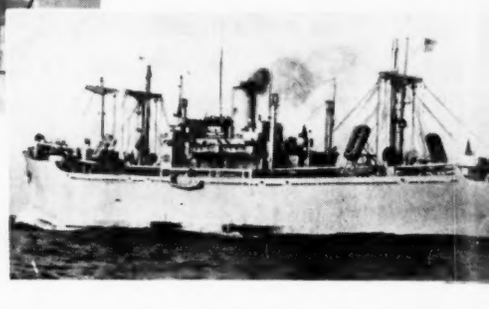
AMMONIA VALVES · FORGED STEEL VALVES AND FITTINGS FOR OIL, STEAM AND OTHER FLUIDS

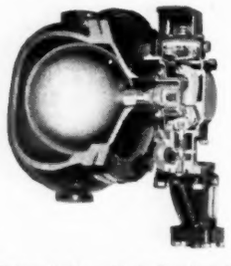




Ocean water—

BUT DRINK ALL YOU WANT!

McDonnell No. 47-2 Feeder Cut-off Combination. The most widely used and proved combined boiler water feeder and low water cut-off for automatically fired boilers with capacities up to 5000 sq. ft., maximum steam pressure, 25 lbs. It may also be used without the low water cut-off switch for hand fired boilers.



McDonnell No. 51-2 Feeder Cut-off Combination. The No. 51-2 takes care of the automatically fired boilers above 5000 sq. ft. capacity, maximum steam pressure, 35 lbs. It may also be used without switch for hand fired boilers. The control used on the B & G distilling unit is similar in basic construction to this control. Other types cover a wide range of boiler capacities and pressures.

THE Ancient Mariner's lament, "Water, water everywhere, but not a drop to drink", doesn't apply when this Bell & Gossett evaporator and distilling unit is aboard ship. It performs the vital job of converting ocean brine into pure drinking water on AP2 and AP3 cargo ships like those illustrated.

The important assignment of controlling the flow of salt water to the unit in accordance with the rate of distillation is in the hands of a dependable McDonnell No. 2155 water level control. This is a variant of the McDonnell No. 51 boiler water feeder, equipped with a larger valve orifice and built to feed through the float chamber as dictated by design considerations.

Here, again, you have one of many examples of new and special uses of McDonnell Boiler Water Level Controls that have heaped new problems on us and over-taxed our production to the point where even orders carrying high ratings must often be delayed.

To an organization that has always taken pride in same day deliveries this is a bewildering condition to face. However we know, as you know, that the only good traffic rule on the road to victory is "first things first"!

McDONNELL & MILLER, Wrigley Building, Chicago 11, Illinois

Doing One Thing Well

REG. U. S. PAT. OFF. — SAFETY CONTROLS

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BOILER WATER FEEDERS • LOW WATER CUT-OFF

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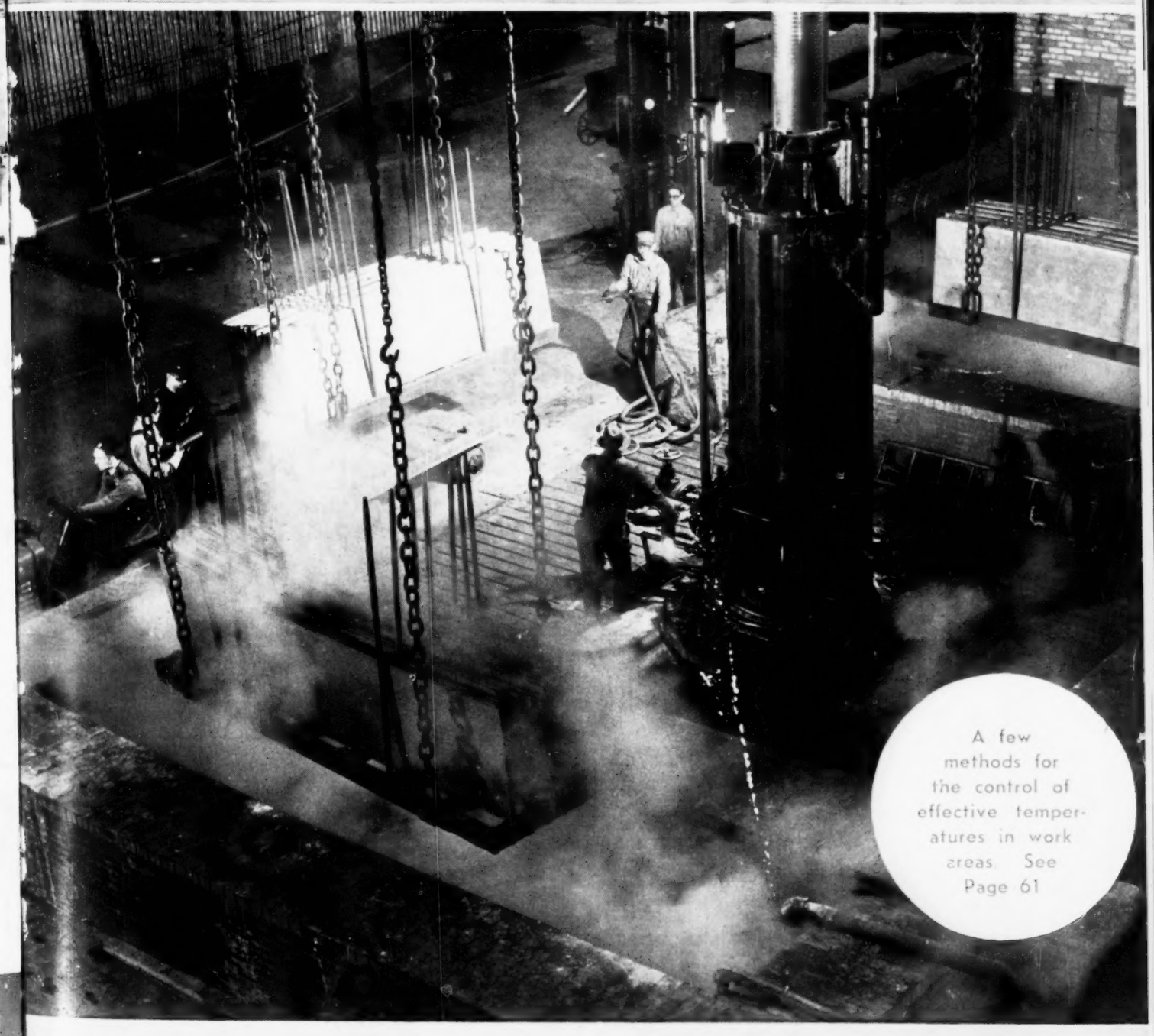

A few methods for the control of effective temperatures in work areas See Page 61

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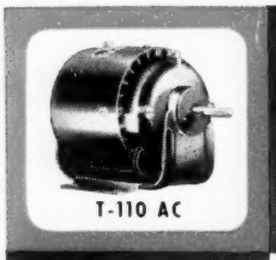
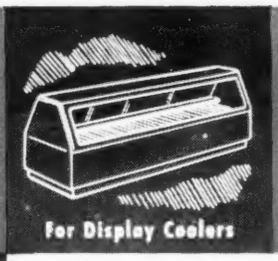
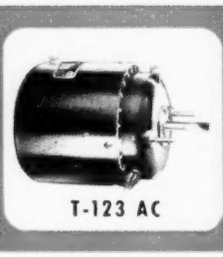
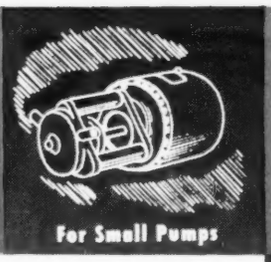
Correcting Errors in Duct Design . . . page 86

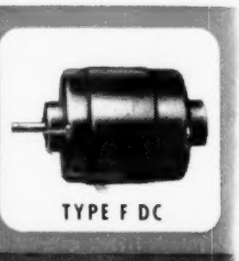
Radiant Heating System Control . . . page 78


T-110 AC


For Display Coolers


T-123 AC


For Small Pumps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For Air Conditioners

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Composite view of Redmond facilities

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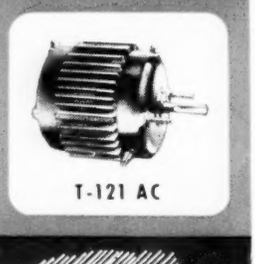
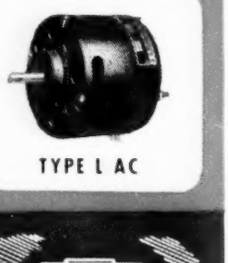
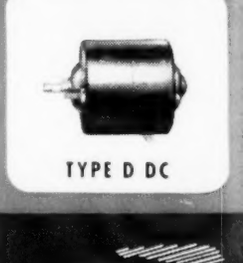

T-121 AC

TYPE H DC

For Ventilators

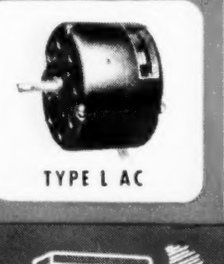
For Top Lifts


TYPE L AC

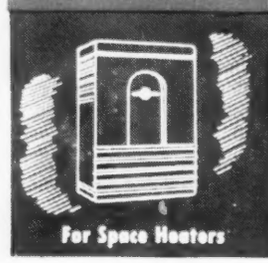

TYPE D DC

For Oil Ranges

For Car Heaters

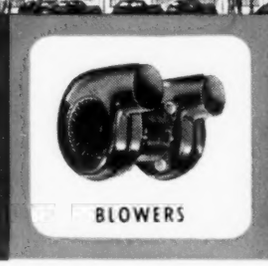

TYPE L AC

DYNAMOTORS


For Space Heaters

CONTROLLERS

For Furnaces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All representatives of Reznor Manufacturing Co., makers of Reznor Unit Heaters, are certified heating engineers or have had broad heating experience. They know the answers and they can pass along many sound suggestions.

For ready reference, jot down the name of your nearest Reznor representative or file this page. Remember the name—REZNOR, the oldest name in gas heating equipment.

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